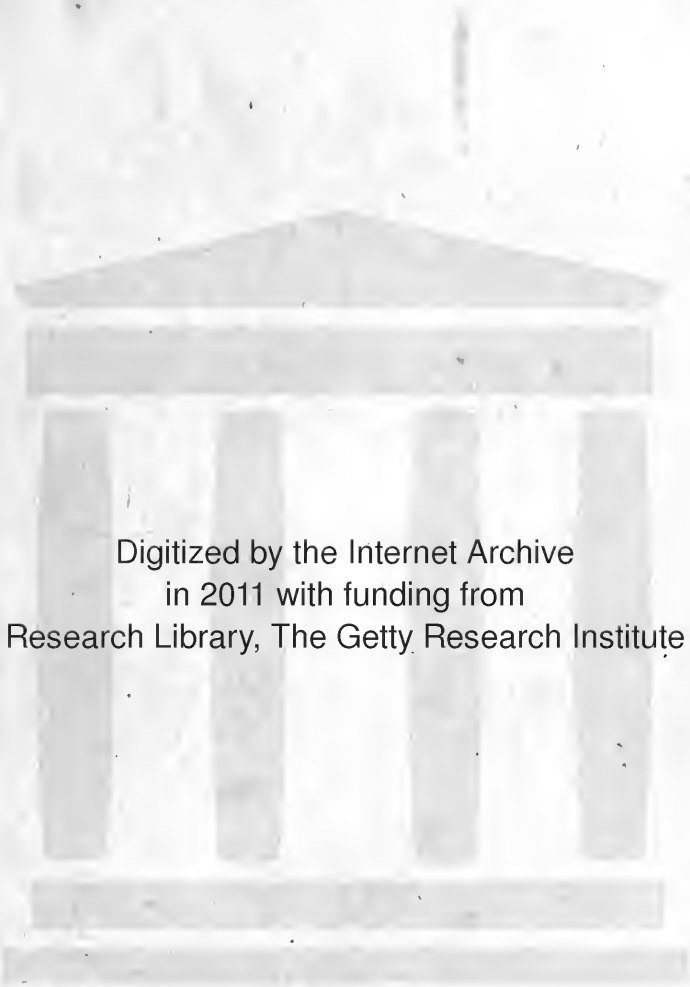

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ARCHITECTURAL

MAXIMS AND THEOREMS.

ARCHITECTURAL
MAXIMS AND THEOREMS

IN ELUCIDATION OF

SOME OF THE PRINCIPLES OF

DESIGN AND CONSTRUCTION:

AND

LECTURE

ON THE

EDUCATION AND CHARACTER OF THE ARCHITECT.

BY

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"Parmi les choses, que nous cherchons à connaître, il faut considérer, que les unes dépendent seulement de la mémoire, et sont purement historiques, n'ayant alors pour objet que de savoir ce, que les auteurs ont écrit. Les autres dépendent seulement du raisonnement et sont entièrement dogmatiques, ayant pour objet de chercher à découvrir les vérités cachées."
—*Pensées de Pascal*, p. 1. art. 1.

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TO THE RIGHT HONORABLE

THE EARL OF AUCKLAND, G.C.B.,

FIRST LORD OF THE ADMIRALTY

AND

PRESIDENT OF THE SENATE

OF

UNIVERSITY COLLEGE, LONDON,

THE FOLLOWING PAGES ARE INSCRIBED

AS A MARK OF GRATEFUL RESPECT

BY

THE AUTHOR.

PREFACE.

All, who have studied Architecture in the works of the masters, will have observed, that although all treat of the principles, which govern the art, they seldom attempt to lay down clear and definite rules couched in simple terms. The laws are not expressed in an axiomatic form or as a series of distinct propositions. As many other branches of learning have that advantage, it may possibly be useful to the professional man, to have this attempt to reduce some of the canons of the art to the forms of theorems, briefly expressed. The writer is conscious how imperfectly this has been realized. But perhaps the

idea, if a good one, will hereafter be more fully developed by men better able to cope with the subject.

It will be perceived, that the subject has been divided into two parts—the Art and the Science; or, if it may be said with the schoolmen, into the metaphysics and physics of Architecture. The one comprehending the abstract principles of taste in the combinations of masses or substances, and the reason and understanding of the causes of certain emotions produced by them in the mind;—the other treating on the qualities inherent in matter and the proper application and combination of such materials in reference to construction. Differing, as to Architecture at all events, from the dogma of Plato, for we must consider forms as not abstracted from matter, but absolutely confined and determined thereby.

A number of abstruse and independent propositions weary the attention. The author may therefore perhaps be excused in availing himself of every form of expression, which can give

variety and animation to the subject. It is with this view, and not through affectation or pedantry, that the opinions of foreign writers have been occasionally adopted in their own languages.

Vitruvius, Alberti, Palladio, Milizia, Quatremère de Quincy, Blondel, Rondelet, Wotton, Woods, Eaton Hodgkinson, and other authors have contributed essentially to the collection, and the experience and suggestions of C. H. Gregory, Esq., C.E., and Mr. C. H. Smith have been of great service in the constructive axioms.

The writer's object has been to render his paragraphs suggestive, rather than complete in all their points: to promote discussion, and thus to excite, rather than to satisfy, the thoughtful reader. Some of the maxims may appear paradoxical, others empirical; but it is time, that architects should apply themselves in earnest to the subject, so that the first principles, such as those propounded in No. V. and the note, and in No. XXII. &c. should be thoroughly investigated.

We ought no longer to have to wander in uncertainty, as to the laws of our art, after the experience and lessons to be derived from the monuments erected during 4000 years.

It may appear remarkable that this has not been done before; but the observation of a correspondent in the Mechanics' Magazine for April last is most apposite, and explains the reason—"The principles of a science are always those, which are learned last. A full, clear and comfortable grasp of those fundamental notions, on which a science is founded, is only attained after a long course of intimacy with the working of the details."

Bolton Gardens, Russell Square,
June 1847.

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MAXIMS AND THEOREMS.

PART I.—FINE ART.

PART II.—CONSTRUCTION.

N.B. This classification is purely arbitrary, as some of the subjects are absolutely inseparable. It has been thought, however, better to make this subdivision, imperfect as it is, in order to assist the reader to some extent.

EDUCATION AND CHARACTER

OF THE

ARCHITECT.

ARCHITECTURAL

MAXIMS AND THEOREMS.

PART I.

FINE ART.

"The writing in Aphorisms has many excellent virtues, whereto the writing in method does not approach."

BACON, *Advancement of Learning.*

ARCHITECTURAL MAXIMS

AND

THEOREMS.

OF ARCHITECTURE IN GENERAL.

I.

"ARCHITECTURA est scientia pluribus disciplinis et variis eruditionibus ornata."—*Vitruvius.*

II.

"Architecture can want no commendation where there are noble men or noble minds."—*Wotton.*

III.

Architecture arises from a common want, is cultivated from the desire of improvement, and derives from philosophy its complete development; its object being to erect buildings, which shall be durable, fitting, and beautiful.

OF THE ÆSTHETICS OF ARCHITECTURE.

IV.

Architecture is an aggregate of the Fine Arts; if alone, she is deficient in expression; if united to one only, she is still incomplete; and only acquires all her majesty when combined with both her Sisters.

V.

There are three principal gradations of proportion in all objects: thus in nature there are the tall, the short, and the mean between the two; the strong, the weak, and the mean between the two. So in Classical Architecture, the same modifications are developed in the æsthetical divisions, known as the Orders. Strength and robustness are characterized in the Doric—refined and modified as a mean in the Ionic—and attenuated to greater grace and elegance in the Corinthian. The Italian masters, when they classified ancient Architecture into five orders, abandoned the philosophy, which guided the Greeks in limiting the orders to these three leading expressions of proportion and ornament. There can be only

three orders of Classical Architecture and no more*.

VI.

In Architecture the term Order signifies properly, not merely the column and its superincumbent entablature, but rather a recognised principle of decoration, a systematic arrangement, a certain characteristic proportion, which pervades not only the column and entablature, but also all the other accompaniments in a building, and all the minute details of the several parts.

* A triple division is apparent in mediæval art—as the Byzantine, the Lancet, and the Ogival styles. There are also three primitive colors; and grammarians have a like gradation in the positive, comparative, and superlative degrees of comparison. The crust of the earth is mainly composed of three materials—silex, argil, lime. In time, there is the past, the present, and the future. It is not to be supposed that the man of genius is held in unworthy thraldom by the determined proportions of the three orders. Each order has in itself a like triple division, as the Doric of Magna Græcia, of the Theseum, and of the Athenian Agora; the Ionic of the Ilyssus, of Ionia, and of the Erechtheum; the Corinthian of Tivoli, of Mars Ultor, or of Jupiter Stator. Thus, after all, the Tuscan is but a simplification of the Doric, and the Composite an amplification of the Corinthian—modifications, not distinct ideas. The Ogival again may be divided into decorated English, Flamboyant, perpendicular. The architect, therefore, with a rich and well-directed genius, knows how to produce an endless variety, without trespassing beyond the well-defined limits of each order and style.

VII.

The three Classic Orders contain all the fundamental principles of the Æsthetics of Classical Architecture; but Architecture comprehends more than the three Orders.

VIII.

There are some, however, who consider the Orders in the same light as the Æolic, Doric, Ionic, and Attic dialects among the Greeks. That, however, was merely a verbal or literal variation, not affecting the meaning. To handle the Orders, therefore, as the dialects, were to lose their high purpose and essential quality.

IX.

Each style of Architecture has its conventional laws of propriety, and its canons of beauty in form and proportion. These cannot be transgressed without a sacrifice of the leading emotions and impressions, which they are calculated to produce. Mediæval or Chinese or Moorish art is as imperative and arbitrary in this respect as the purest styles of the Classic periods.

X.

Who shall say that Greek architecture is

poor, because its mouldings are few? Seven musical notes have sufficed for thousands of exquisite melodies, and each nation has its own peculiar airs. Who shall count the endless varieties produced by twenty-four letters since language first assumed its written form?

XI.

"It was not by a multitude of different and isolated impressions that the Greeks sought to interest, to move the feelings, and to satisfy the sensibility. They had only one leading idea; and that was a grand one: they repeated it continually, and they modified it much by all the fugitive adaptations of sensible and insensible gradations of which it was susceptible. The Greeks by this means satisfied two singular caprices of sensibility, which, idle and at the same time craving for something new, seeks to retain the same sentiment and excite a new sensation."—*Dupaty.*

XII.

To the like effect is the opinion of Milizia, that "the ancients accomplished grand works, as in their temples, by attending to the one great purpose of producing a grand impression

at the first glance of a building. They knew not affectation or pedantry. But the moderns are over-scrupulous in minutiæ, lose themselves in littlenesses, and consequently too often only accomplish little things without beauty."

XIII.

Horace Walpole, as quoted by Woods, says, "One must have taste to be sensible of the beauties of Grecian architecture: one only wants passions to feel the Gothic. In St. Peter's, one is convinced that it was built by great princes: in Westminster Abbey, one thinks not of the builder. The religion of the place makes the first impression."

THE AUTHORITY OF ANTIQUITY.

XIV.

Whenever an antique type is adopted in a composition, the sentiment of the original should be adhered to as strictly as possible. But reason will show, that it is right to introduce any sensible modifications in details, which the immediate peculiar purpose of the monument and the fit-

ness* of things may demand;—but still in the spirit of the original.

XV.

A cupola would be incongruous placed on the Parthenon, or the porch of Rheims attached to Santa Sofia at Constantinople.

XVI.

The ancients themselves were in nothing bound by mere precedent. No two monuments of the Egyptian, Greek or Roman artists were precisely alike; yet each was imbued with the leading feature of its style or period: and this feeling was progressive, not retrograde.

XVII.

The works of the ancients were founded upon the finest perception of fitness; yet the rules, which guided them, are not insuperably binding on the moderns. "To look back to antiquity is one thing, to go back to it is another," says Colton. And how full of truth is Bacon's sentence on the same point!—"Antiquity deserveth that reverence, that men should make a stand

* Fitness comprehends not only convenience, but also the appearance of convenience, suitableness to its purpose, and the expression of character in union with the purpose.

thereupon, and discover what is the best way; but when the discovery is well taken, then to make progression."—*Advancement of Learning.*

XVIII.

It is desirable to have the authority of the ancients; but it is not conclusive: for what was proper and indispensable heretofore may now be inexpedient or inappropriate. "Still we must begin by observing what has already pleased, if we wish to judge rightly as to what will please in any future production."—*Woods.*

XIX.

Time cannot render irregularities legitimate, nor can authority justify abuses of taste. On the other hand, a thing is not praiseworthy on the sole ground that it is new. "Ebenche," says Palladio, "il variare e le cose nuove debbano piacere: non si deve però farciò contra quello, che la ragione ci dimostra."

XX.

He, who talks of common sense as superseding all reference to the opinions of those who are gone before, had better cease to speak a cognate language, abandon every known art, and invent

a new order, ere he rejects the experience of ages and the wisdom of thinking men of former times.

PROPORTIONS OF BUILDINGS.

XXI.

Can it be supposed by any, who have thought on the subject, that beauty of form or gracefulness of proportion, even in a moulding, depends upon chance? Some law, known or unknown, rules each.

XXII.

But is there anything more difficult to define than beauty? We know that there is a beauty in form, in color, in expression; still, who shall lay down a law of beauty, which shall embrace under one head the most exquisite productions of the Classic, and Eastern, and Western art, and those of the mediæval periods? Who can reconcile under one common canon the massive column of the Doric and the slender shafts of the Gothic periods? Each has its beauty, and that not a beauty of caprice or fashion. No doubt then that there are different qualities of beauty; but still there must be some leading

principle, of which these are but various developments. "Non ostante questi gusti nazionali, regna nell' architettura un gusto commune, che tocca tutti ugualmente, almeno chiunque ragiona," says Milizia, vite xlvii.

XXIII.

What is the value of Mons. Frezier's axiom? that "beauty in the arts is but a national or educational prejudice, and inconstant, since it depends only upon the fashion of the time." Even Sir J. Reynolds contended that beauty was conventional: "One man," says he, "prefers a swan, another a dove." True; but who prefers a goose to a swan?

XXIV.

"To produce the effect of magnificence in Architecture, three things seem to be necessary —greatness of dimension, simplicity of design, and appropriate decoration. To satisfy the mind after examination, three other things are requisite—correctness of proportion, graceful drawing, and delicate execution. Of these six points, St. Peter's has the first in a high degree, something of the second, and a great deal of the third: the three latter it also possesses, though not in

a very remarkable degree: the proportions do not offend, and the drawing and execution are good."—*Woods*, vol. i. p. 380.

XXV.

"May we not presume," says George Moore, "that the sublime emotions called forth by a view of the exterior of a grand building, such as the temple of Apollinopolis Magna in Upper Egypt, are chiefly due to the very great extent of its dimensions, the massive character of the composition, and the boldness and breadth of all its parts?"

XXVI.

Is not proportion the principal ingredient of beauty in Architecture? And may we not concur with Blondel, when he says (l. v. c. xv.), "Toute la beauté de l'architecture, toute sa grace, et enfin tout ce qu'elle a, qui peut plaire, s'efface et s'en va en fumée aussitôt qu'il n-y-a plus de proportion?"

XXVII.

"For the simplest and least-embellished edifice, if it have the merit of just proportion, will produce a satisfactory impression; whereas the

most decorated buildings, if devoid of proportion, can never be beautiful*."—*Milizia.*

XXVIII.

Unity without variety produces uniformity and insipidity. From variety without unity result confusion and distraction.

XXIX.

To be always sublime is to fail of true elevation. Both the mind and the eye require occasional repose, as well as measures and degrees of comparison, to appreciate grandeur.

XXX.

In each work there ought to be a progressive march of effects; nevertheless we must not forget the precept of Palladio—"Che gli edifici abbiano da parere uno intiero e ben finito corpo." —*Lib.* i. *c.* i.

XXXI.

An architectural object pleases the eye, when its leading parts are so arranged, that the atten-

* As in a picture fine chiaroscuro, brilliant and harmonious colouring, and good composition, do not compensate the absence of correct drawing.

tion is successively and correlatively struck by the most essential down to the least important feature.

XXXII.

Even the accessories ought to have such an appropriate relation to the whole, that they should not be absorbed by the mass; but be capable of exciting distinct ideas in just relation to their purpose.

XXXIII.

Yet, as Woods judiciously observes, "Nothing has a worse effect or has spoiled more beauties, than the desire to give great consequence to the subordinate parts; for there are no positions more certain, than that unity of design is essential to magnificence, and that in order to preserve unity of design the inferior parts should not form independent compositions."

XXXIV.

Still all dressings should have an imposing size and dignity of character, adapted to their purpose; if slight and insignificant, they appear merely ornamental, and no useful member should be degraded to so low a purpose—as mere ornament.

XXXV.

But how absurd is the question, "What is the use of ornament?" Well says Woods in reply, "Magnificence is use when well-employed; it is calculated to produce respect and awe, or at least a frame of mind which readily admits those sentiments, and therefore it ought to be found in public edifices, and still more in and about the temples of the Deity."—*Vol.* i. *p.* 376.

XXXVI.

Where all is moulded, and every moulding carved, mass is without proportion, and profusion without richness. Thus, in the later productions of the Roman empire, ornament is loaded upon ornament, until it sickens the beholder.

XXXVII.

An order, when introduced, should be the predominant object, without appearing colossal or gawkish*.

XXXVIII.

If massive columns are close to each other, they appear more massive still; and slender columns, when wide apart, appear slenderer still.—*Milizia.*

* As in the Valmarana palace at Vicenza by Palladio.

XXXIX.

Intercolumniations should never be so wide as to diminish the real or apparent solidity of the entablature; nor so narrow as to afford insufficient space for passing through.

XL.

It may be tolerable to omit a usual member of architecture; but insufferable to put it in the wrong place.

XLI.

The leading canons of the art, founded upon the laws which govern nature, cannot ever be contravened with propriety in any style; but those laws, which are purely conventional, are binding only in the style to which they belong.

OF EDIFICES AND THEIR PARTS.

XLII.

"Buildings should have the four following qualities: health, solidity, convenience, delight." —*Milizia.* Convenience and the appearance of convenience are the result of design; strength and economy the end of construction.

XLIII.

The elevation is to a building what the countenance is to the mind, and either prepossesses in its favour or prejudices with dislike.

XLIV.

There are two principles of composition for elevations—the horizontal and the vertical; one of these must predominate. In the classic buildings of antiquity the former prevailed. The latter arose in the decline of Roman architecture, is triumphant in the edifices of mediæval art, and reigns throughout with the upshooting tendency in the buildings of the Eastern world, as in the minarets of the Mahomedan and the pagoda of the Chinese.

XLV.

"Art is but nature better understood;" for from the forms of nature we deduce our ideas of the beautiful. Nature is consistent in usefulness and beauty: hence we find in art that the slightest proportions and most graceful forms, executed in hard and enduring materials, are quite compatible with durability and strength. Solidity does not necessarily and exclusively

consist in ponderousness of bulk. The steam-engine at first was a clumsy, heavy, complex machine; it is now more simple, more efficient, less bulky, and more graceful.

XLVI.

A building may be embellished in three manners: by the richness of the material; by the richness of the workmanship; or by a combination of the two.

XLVII.

Each edifice, having its peculiar appropriation, demands that the impress of its distinctive character should be visible in its aspect. The imposing and solemn temple, the splendid and commanding royal palace, the embellished residence of the noble, the gloomy prison, the cheerful theatre, should immediately announce their purpose and destination. If not, where is expression in Architecture?

XLVIII.

"Venustatem persequitur visus," says Vitruvius: therefore to decorate an object is for the purpose of developing sources of sensations and

impressions, in addition to those produced by the simple object itself.

XLIX.

How fine and striking is the description of a private residence given by Wotton at the commencement of his 2nd part!—"Every man's proper mansion-house and home is the theatre of his hospitality, the seat of selfe-fruition, the comfortablest part of his own life, the noblest of his sonne's inheritance, a kind of private princedome. Nay, to the possessor thereof, an epitomie of the whole world."

L.

All voids and solids should be on their respective axes throughout: in plan for beauty—in elevation for strength.

LI.

Three principles must be observed in the adoption of any object or member, or detail in Architecture — appropriateness — proportion — form. Appropriateness comprehends the two requirements of Vitruvius, "quod significandum, quod significat," b. i. c. 1.

LII.

Construction should be the origin of decoration and ornament; but in its turn should be subservient to them, as in the flying-buttresses of our Gothic edifices.

LIII.

True beauty cannot be apart from convenience. The most beautiful will be the most convenient; but the converse proposition is not a corollary thereto.

LIV.

The circular form contains beauty, convenience, and strength. By its graceful line it pleases the eye; it affords great facility of arrangement in plan; and by the concentric disposition of its cuneiform masses or blocks, it enables the architect to overcome difficulties of construction otherwise insurmountable.

LV.

Staircases require to be near the entrance, ready of access, easy of ascent, rarely circular, and to be well-lighted.

LVI.

" Each edifice has its own point of view, dependent on its form, size, and decoration."—*Milizia.*

LVII.

Symmetry should reign in every architectural production, for Blondel (l. v. c. xv.), insists that " toute la beauté d'un batiment s'évanouit au moment, que l'on change quelque chose d'essentiel à la symmétrie." Still, without variety none can please. " Senza varietà tutto languisce," observes Milizia.

LVIII.

Where eurithmy is absent, confusion reigns; and it is only the ignorant, who will consider a work fine because it is intricate and appears difficult.

LIX.

There may be as much purity in picturesqueness as in forms or parts the most conventional; consequently picturesqueness is no excuse for crude forms or barbarous parts.

LX.

There must be harmony in contrasts, and con-

trasts in harmony: a balance of opposites to produce effect. "Contraria juxta se posita magis illucescunt" is an old rule, observes Wotton. For, as D'Aubigné says, "unity in diversity and diversity in unity is the law of nature."

LXI.

"To be rich without profusion, simple without barrenness, is the great aim of an architect," said the celebrated Percier to me in 1822.

LXII.

Nevertheless Blondel is most correct, where, in the 16th chapter of his 5th book, he says, "La beauté de la matière et la délicatesse de l'exécution servent infiniment à relever l'excellence de celle, que les proportions font naitre dans les édifices."

LXIII.

The eye of the ignorant or vulgar cannot appreciate many of the nice "*nuances*" essential to beauty. Woods, with his usual penetration, observes, that "It is quite a mistake to suppose that a variation of form, not immediately perceptible to the eye, must therefore be useless. Every artist has felt, that these slight changes

influence the charm of the composition without being themselves obvious even to a skilful observer*."—*Vol.* i. *p.* 337.

LXIV.

If a difference of size in parts or details exist in a building, and be not discoverable unless one takes a compass, a rule, a square, or a level, they are no longer defects. Buildings are not made for measurement, but delight. When these discrepancies escape the eye, and minute examination can alone detect the irregularity, the beauty of the whole does not cease to affect us. In the Pantheon the angular columns are anti-Vitruvian, being smaller, instead of larger, than the others. At the top of the pediment there is a double modillion ; and on one side of the sloping cornice twenty-four modillions, on the other twenty-two. "Bravo," says Milizia, "to him who has counted them ; but più-bravo to him who turns up his nose at such microscopic criticism."

LXV.

There is no part of a building, which has not the power of adding considerably by appropriate treatment to the effect of the edifice. Witness

* As in the entasis and convexities of Greek Architecture.

even the chimneys of the Tudor or Elizabethan houses, and the lofty shafts which rise above the roofs of the Tuileries, and of the other palaces of the Renaissance and the Châteaux of France, as given by Du Cerceau, Marot, Baltard and others.

LXVI.

There is as much of reason in the introduction of light and shade and color, as in the distribution of the masses. In fact, as Woods remarks (vol. i. p. 432), "coloring and composition mutually enhance each other."

LXVII.

A subdued light becomes a church: "devotion," as Wotton suggests, "more requiring collected than diffused spirits."

LXVIII.

The more light there is thrown on an object, and the lighter its color, the nearer it appears; but objects obscurely lighted appear more distant than they are in reality, and the larger in proportion to the weakness and obscurity of their color (*Milizia*).

LXIX.

The more distinct the parts of an object, the

nearer it seems to be; and the more confused the parts, the more distant it appears.—*M.*

LXX.

Are not size and color relative, and not positive qualities; and contrast the only scale of either* ?

LXXI.

In fact, can any effect be produced without contrasts? But all contrasts must have relation to each other to produce a just effect, and a *tertium quid* to prevent rude and harsh juxtapositions of contraries: a middle term, as it were, to complete the architectural syllogism.

LXXII.

The youthful period of any new style of art has certain impulses, but no fixed laws. Mature age alone brings experience, and experience alone is capable of establishing fundamental principles and a legislative code.

* The ancients treated this point in a most masterly manner. Most of their temples were enclosed in courts. The Trajan Column was placed in a confined area. They would not have placed a colossal statue on a lofty arch, at a distance from every object that might give a scale, by which to judge of its position and relative size.

LXXIII.

" There are three leading points in every fine building: its execution—its magnificence—its conception. The glory of the first is due to the builder; of the second, to the owner; of the third, to the architect."—*Blondel.*

OF THE ARCHITECT.

LXXIV.

The Architect has much to learn—much to feel—much to do.

LXXV.

Let no one in the pursuit of his profession doubt, whether he is actuated, as to his motives, by a love of praise, a desire of gain, a passion for art, a spirit of rivalry, or the generous desire to be useful. " Philosophia vero perfecit architectum animo magno, et uti non sit arrogans, sed potiùs facilis, æquus et fidelis; sine avaritiâ, quod est maximum; nullum enim opus verè sine fide et castitate fieri potest: ne sit cupidus, neque in muneribus accipiendis habeat animum occupatum, sed cum gravitate suam tueatur dignitatem,

bonam famam habendo. Hoc enim philosophia præscribit."—*Vitruvius.*

LXXVI.

It should be the purpose of the architect to allow no day to pass without adding a sketch to his collection. His motto should be with Titus: "Nulla dies sine lineâ." "For there cannot be a more baneful error," observes George Moore, "associated with initiation into art, than the dangerous dogma, that the aspirations of genius need not be trammeled by the labour of study." (p. 35.)

LXXVII.

The life of an architect is one of continual reasoning: no two buildings, which he may be called upon to design or contemplate, can be precisely alike. It requires therefore an exquisite susceptibility, unwearied patience, and sound judgment to know in what respects they differ, and how the necessary difference should be, or has been, satisfied.

LXXVIII.

Invention and judgment distinguish the true artist. The critic need only possess the latter.

LXXIX.

The severest discipline of the eye and hand is essential to him, who would produce enduring works.

LXXX.

To study aright the monuments of antiquity, the student must first scan the powerfully effective combinations, which produce the more striking impressions, influencing the feelings and opinions ; and then descend to the minute axioms, which contribute to the effect of the whole. He must distinguish the transitory and accidental circumstances from the essential and immutable laws of the art.

LXXXI.

The architect has to respond to each sentiment of the human mind. He has to produce appropriate impressions of sublimity, awe, veneration, grandeur, strength, solidity, durability, lightness, cheerfulness, gaiety, comfort, convenience, health. In fact, there is an expressive and deep-feeling poetry in the art, which if a man cannot attain, he must not aspire to be an architect.

LXXXII.

To be a good architect one must be a good designer: but a good designer is not necessarily a good architect. Vitruvius distinctly says: "Architecti scientia nascitur ex fabricâ et ratiocinatione." (b. i. c. 1.)

LXXXIII.

Architecture has this distinctive feature from any other department of learning, that it is essentially composed of two divisions—Imagination and Reason. Deprive it of the element of taste, it assumes the form of a mere mechanical science. Take away its element of sound construction, its flights in the regions of fancy degenerate into wild caprice and extravagance, having no ennobling end or object.

LXXXIV.

How much of truth is there in the casual remark of Woods, that "All becomes gold in the hands of a skilful architect; but the finest parts and most exquisite proportions turn again to dross in the hands of ignorance and insensibility!"

LXXXV.

Strong impressions are not necessarily correct

ones ; therefore no reliance can be placed upon the emotions derived from the senses, unless confirmed by the reason ; but we depend upon our senses, which are at the same time our masters and our ministers. How much caution therefore is necessary in adopting them ! for, as Blondel observes in the 14th chapter of his 5th book : " Nous prenons ordinairement pour vraies les choses, qui nous paraissent les plus claires et les plus évidentes ; sans considérer, que cette évidence ne vient souvent que de la facilité, que nous avons à les comprendre et à nous les présenter telles par l'habitude, que nous avons contractée, à force de les avoir souvent considérées de même manière."

LXXXVI.

He cannot improve in his art, who is not conscious that he is far from perfection. " I am diffident," said the celebrated James Watt, " because I am seldom certain that I am in the right, and because I pay respect to the opinions of others, where I think they merit it."

LXXXVII.

Wotton asks in his usual pithy way—" What

are the most judicious artisans, but the mimiques of nature?"

LXXXVIII.

But this "mimique" of nature is not to be a plagiarist of nature. Architecture has its conventional laws; and a flower or a leaf even, introduced in a moulding, a frieze, or a capital, must be æsthetically modified to adapt it to its application. Witness the sovereign skill with which the Egyptian, the Greek, the Roman, the mediæval artist has created a botany of architecture. The parsley, the acanthus, and the vine, engrafted on a column, have by the combination acquired a new development, an imaginative creation of art.

LXXXIX.

"The *beau idéal* is different from drawing, because it depends upon the choice of subject. One artist may draw commonplace forms, and such as he usually sees, with perfect exactness. A second may know how to select the most beautiful. A third, by a careful examination of what constitutes the excellence of each part, and by the harmony and correspondence of one part

with another, may improve even upon the most beautiful existing figures."—*Woods*, vol. i. page 431.

XC.

In fact, good taste in ornamentation does not depend upon a mechanical and superficial imitation of any object, but upon a studied observation of natural objects, and of the mode in which they can be applied to a purpose totally foreign to their original nature.—*Arch. Egyptienne, Q. de Quincy*, p. 156.

XCI.

He, who copies, is bound by the letter of the original. He, who imitates, is bound only by the spirit and essence of the type: for in copying is not the most exact copy the best? but to copy is not to create, and true originality does not consist merely in variation.

XCII.

"It is a sterile fecundity," says Quatremère de Quincy (p. 177), "whose power of production consists only in changing, and changes only in order to appear to produce, without any valid or apparent reason for such varieties."

XCIII.

To copy is the instinct of the mere animal faculty; to imitate is the property of reasoning intelligence. In fact, "the proper use," as Poynter suggests, "to be made of the study of the ancients in their works of art is not to copy, but to endeavour to think like them."

XCIV.

A first idea is rarely otherwise than crude; absolute perfection is unattainable. But improvement can only be realized by elaboration.

XCV.

A general impression may be correct; a perfect appreciation however of any work of art cannot be arrived at without thorough study.

XCVI.

"All license is imperfection," says Laugier; and very justly, for license presupposes a departure from good taste.

XCVII.

He, who does not feel that beauty is greatly to be desired, and that ornament well-applied

enhances beauty, should give up all connection with the fine arts.

THE HISTORY OF THE ART.

XCVIII.

No branch of architecture can be properly studied, when we limit the consideration to the productions of one country or of one epoch. He alone appreciates the full privilege of his art, who studies the class rather than the individual. Each country has its illustrations ; but the whole world alone contains the full development, and all ages its entire history.

XCIX.

The history of architecture is not easily appreciable, unless we keep in mind certain grand periods and their dominant types, which, as leading features, distinguish each aspect presented by the monuments of the several epochs.

C.

He, who expects to be a good architect by

knowing the history of all the styles, and the phases which it has assumed through each period, will find himself much mistaken when he begins to practise. He may be a good historian and judicious critic, but not necessarily a good artist.

ARCHITECTURAL

MAXIMS AND THEOREMS.

PART II.

CONSTRUCTION.

"Knowledge, while it is in aphorisms and observations, is in growth."

Bacon.

CONSTRUCTION.

CI.

To collect physical facts, to deduce laws, and to apply them to circumstances, such is the progressive operation of the mind in the study and application of *construction*.—*Lacroix*.

CII.

Construction has for its laws the principles which govern matter; for materials, the productions of the vegetable and mineral world; and for its end, resistance to weight, a successful struggle with the elements, and victory over decay.

CIII.

There are three leading points of view under which to regard all construction—statical, qualitative, quantitative. Statical relates to the disposition of the masses: the two latter points refer to the quality and quantity of the materials, which have a mutual relation and control as to solidity and stability.

CIV.

It is incorrect to regard decay and destruction as entire annihilation of substance. Decay is but a species of transition from one state to another. The first elements of any substance, which is reduced to a powder, sublimated to a vapor, or converted into a gas or steam, still exist in another form, assuming a new combination.

CV.

Ignorance, haste and parsimony are three great enemies to substantial construction.

CVI.

The rot in timber germinates in damp, expands in heat, but shrinks and dies in perfect ventilation.

CVII.

Green wood laid in peat will last for ages.—*C. H. G.*

CVIII.

Expansion and contraction, the effects of temperature, are constantly operating in all construction the most solid, in all materials even the most dense. Hence a perpetual movement

destructive of cohesion, and by disintegration inducing decay.

CIX.

Water is the most destructive agent to construction. There is no quantity so small, which, if repeated, is not ultimately fatal. The softest as well as the hardest material must yield to its insidious attack. No adage more true than "Gutta cavat lapidem."

CX.

Our forefathers knew the connection between moisture and decay in soft material. Hence in the buildings of the districts where the soft stones prevail, the bottom courses of the walls will frequently be found to be formed of a hard and impervious stone, the strata of which are called by the quarrymen foundation-stone.—*C. H. G.*.

CXI.

Walls, always above or always below water, may under certain circumstances be laid without mortar; when between wind and water they never should.—*C. H. G.*

CXII.

"All the mechanical effects, that tend to destroy buildings, arise from weight, which acts in an inverse ratio to resistance," says Rondelet. How important then the study of the mutual relations of void and solid, load and support, action and resistance!

CXIII.

Weight is a constant force, with which all solid bodies appear to act.

CXIV.

All parts of solid bodies fall in a vertical direction.

CXV.

All thrust and lateral pressure, whether in a truss, a buttress, a dome, a vault, or arch, must be resolved into vertical weight.

CXVI

Lines of pressure must always be at right angles to the joints of the beds.

CXVII.

The true strength of materials in construction depends rather upon their distribution or their application than upon their quantity.

CXVIII.

Voids over voids, and solids under solids.

CXIX.

He is the ablest constructor, who, with the least surface to his points of support, upholds the greatest weight, uniting strength and economy.

CXX.

The Freemasons of the middle ages have established this principle of construction, that, with equal quantities of material, a thin wall with buttresses has greater strength and stability than a thicker wall without.

CXXI.

Piers with equal superficies of base, as a circle, a square, an equilateral, and a right-angled triangle, have the following strength approximatively: 100, $93\frac{1}{2}$, 86, and $76\frac{2}{3}$. A square is to a parallelogram as 100 : 95.

CXXII.

The strength of a wall depends rather upon its stability, than upon the greater or less hardness of the materials.

CXXIII.

The stability of solids diminishes in proportion to the height of the centre of gravity.

CXXIV.

Strength sufficient (for the immediate purpose) is not strong enough, therefore it is better to have too much solidity than too little.

CXXV.

Nevertheless all *unnecessary* material is not only wasteful, but prejudicial.

CXXVI.

No wall, nor framing, nor in fact any piece of construction, ought to be charged with more than two-thirds of the load which it is calculated to bear : in railroads, where the load is variable and concussion takes place, the law is one-third.

CXXVII.

Tredgold in his Essay on Cast-Iron lays down two leading principles—"That the measure of the resistance of a material to flexure is the only proper measure of its resistance (to a straining force), where perfect form and unalterable position are desirable:"

CXXVIII.

And that "the measure of its resistance to permanent alteration is the proper resistance (to a straining force), where flexure is not injurious or objectionable."

CXXIX.

It is not the fracturing weight, which is required in practice; but that weight, which will not injure the material.

CXXX.

Permanent alteration of form, however slight, is partial fracture.

CXXXI.

Eaton Hodgkinson, in his Supplementary Part II. to Tredgold's work on Cast-Iron, says, "that

there is no weight, however small, that will not injure elasticity."—*Page* 381.

CXXXII.

A beam will bear twice as much weight distributed over its length, as it would do, if the weight were in the middle.

ON MASONRY.

CXXXIII.

"All stones, even those of the least cohesive strength, are strong enough to support any weight they can be brought to bear in construction under ordinary circumstances."—*C. H. Smith.* That stone must be soft indeed which, laid upon a sufficiently wide basis and a perfectly equal bed, can be crushed by any weight.

CXXXIV.

Materials of different powers of resistance may be placed so as to counteract one another; but not to act in concert. Soft and hard stones should not be laid in the same course; but they may be placed one above the other.—*C. H. G.*

CXXXV.

Quoins of buildings and walls should always be carefully protected in the foundations, and well-bonded in the superstructure. At the angles unequal settlement most frequently shows its effects; but when quoins are well-supported, they will keep up a weak wall. The Gothic architects were well-aware of this; hence the immensely projecting buttresses at the angles of their lofty towers.

CXXXVI.

The material available must frequently have determined the style of art. The granitic and hard rocks, which line the Nile, must have motived the massive piles of the Egyptians. The freedom of marble doubtless influenced the Attic taste; and the coarse texture suggested the heavy ponderous character of the monuments of Magna Græcia. The like consideration controls the introduction of more or less ornamental detail in edifices.

CXXXVII.

The greater the thickness of a block in proportion to its base, the greater its strength; and the larger the base of a block, the greater its stability.

CXXXVIII.

The heaviest stones are generally the darkest coloured, the hardest, the strongest, the most homogeneous, and of the finest grain.

CXXXIX.

Less force is necessary to split hard stones than to crush them; less to crush soft stones than to split them.

LIMESTONES AND MORTARS.

CXL.

In all mortars there must be two essential solid ingredients, in addition to the water: the one active and chemical, that is, the calx or lime; the other inert and mechanical (?), as grit, ashes, &c.

CXLI.

Limestones vary in quality according to the substance which they contain in addition to lime. But all pure lime is of the same quality

and strength, whether derived from stone, shells, or any other calcareous substance.

CXLII.

Clay in the limestone gives strength to the lime, and hence the setting properties of Mertsham, Dorking, and blue lias limes; the relative strength depending upon the greater or less quantity of clay in combination with the lime.

CXLIII.

Cement is always weakened by the addition of sand; but pure lime requires the addition of sand to constitute mortar.

CXLIV.

The core of lime is more easily detected in the hard than in the soft stones: hence one of the advantages of using the former.

CXLV.

Sand for mixture with lime should be perfectly free from impurities, highly angular to render it sharp, and not very minute in grain.

CXLVI.

Sand in a moist state occupies less bulk than when dry.

TIMBER.

CXLVII.

Oak for durability and strength; mahogany for beauty and size; fir for utility and lightness.

CXLVIII.

To obtain the greatest strength in timber, beams, joists, rafters, and brestsummers, the depth must greatly exceed the width—the greatest strength opposed to the greatest strain. A joist 6×3 will bear twice as much if put edgwise, as it would if laid flat.

CXLIX.

If the weight to be supported be in proportion to the length, then the width remaining the same, the square of the depth divided by the square of the length ought to be the same

also—*i. e.* the depth of a joist ought to be in direct proportion to the length, and for stiffness the width proportionate to the depth.—*Woods.*

CL.

Where the question is of a piece of timber supporting itself, the weight is as the length multiplied by the depth, and we must multiply this again by the length for a divisor. A rod of fir inch square, or a plank 10 × 1 laid flatwise, would keep quite straight with a bearing of 5 feet. A piece of timber 10 inches square would swag very much with a bearing of 50 feet.—*Woods.*

IRON.

CLI.

Eaton Hodgkinson* states, that in iron beams the neutral axis shifts its position as the weights on it are increased, and at the time of fracture is near the concave side of the beam.—*Page* 384.

* Experimental Researches on the Strength and other Properties of Cast Iron, &c. &c., Supplementary Part II. to Tredgold's work on Cast Iron, 8vo, London, Weale, 1846.

CLII.

Wrought iron to resist tension, cast to resist compression.

CLIII.

Cast iron resists crushing with about $6\frac{1}{2}$ times as much force as it does tearing asunder.—*Page* 327.

CLIV.

The deepest part of a beam must always be at the point of greatest strain—a condition best fulfilled by the parabola. When distributed uniformly over the whole length, the form should be elliptic: but when stiffness is required, the beam should be of uniform depth.—*Renton.*

CLV.

In the three sections of cast-iron beams ⊥ I ⊤ with the same sectional areas and depths, the relative strengths are 1, 1·085, 1·25: and the last beam with the flange upwards ⊥ is only ·45; the strength of the beam being in proportion to the size of the bottom flange.

GUTTERS AND LEAD.

CLVI.

The bottoms of all gutters, drains, and other conduits for liquids or soils, should approximate as much as possible the curved form.

CLVII.

Gutters should have a fall of at least an inch and a half in every 10 feet of length; not less than two-inch drips at every 15 feet, and be as straight as practicable.

CLVIII.

Cast lead is best for sheets of great thickness, milled lead for thin; the former is the more pure, but more liable to inequality of substance.

CLIX.

All lead for gutters and flats should be laid perfectly loose, and free to expand and contract by heat or cold; never soldered, and never in greater widths than 3 feet.

CLX.

We opened these Maxims with a quotation from Vitruvius: let us conclude the subject with a most just remark of this judicious writer, l. i. c. 1:—

"Cum ergo tanta hæc disciplina sit condecorata et abundans eruditionibus variis et pluribus, non puto posse istos repente se profiteri architectos, nisi qui ab ætate puerili his gradibus disciplinarum scandendo, scientiâ plurium literarum et artium nutriti, pervenerint ad summum templum architecturæ."

ON THE

EDUCATION AND CHARACTER

OF THE

ARCHITECT.

PREFACE.

The following pages contain the substance of the last of a course of Lectures delivered at University College, London. It may appear to some, that in this closing address to the Students I have assumed too lofty a tone, and adopted too high a standard. But those, who are familiar with the ardent feelings and generous enthusiasm of youth, will well conceive how important is the endeavour to excite by all means and thus early in the mind of the pupil an elevated idea of the profession upon which he has entered. He should regard it as demanding the exercise of the widest range of intellect. The teacher should

inculcate the highest elevation of taste and sentiment—the noblest standard of professional morals—the most dignified refinement of habits and manners. Such an estimate, formed at the most susceptible period of life, may supply an important and operative principle. It may afford a stimulus, alike powerful and active, by implanting the love of his profession as a predominant motive. It may impart a charm to its pursuit, and a dignity to even his ordinary avocations, protecting him from the influence of every inferior consideration.

ON THE

EDUCATION AND CHARACTER

OF

THE ARCHITECT.

We now approach the most important subject connected with the profession of Architecture. We have gone through the examination of the various styles, which have existed from the earliest periods of Egyptian art down to the productions of the present day. We have endeavoured to analyse the principles, which have directed the adoption of the proportions and forms of each of the phases, that Architecture has assumed through the space of about 4000 years. We have also examined the progressive improvements, which have arisen in the science of Construction. It now behoves us to consider, how these materials are to be made available—by what studies the student is to render himself fully master of the various subjects, at which we have only taken a rapid and cursory glance. We are to inquire how he

is to prepare himself for the responsible and arduous career, upon which it ought to be his desire and his highest pride to enter with the utmost credit; and how he may thoroughly perfect himself, so as to discharge his duties most advantageously to those, who may require the exercise of his talents, whether it be the state, the nobility, the gentry, or middling classes.

Milizia, in his admirable work on Architecture, observes, that to become excellent in any pursuit two things are absolutely requisite. The first is, to deposit in the memory, as in a vast magazine, many useful objects; the other is, to examine what predisposition one has for fame. This combination ought to determine the class of study to which we would apply ourselves. In proportion as we shall have accumulated a store of physical or general facts, we shall be the better prepared for this or that class of study. The objects treasured in the storehouse of the memory are the fundamental matters for the human understanding to work upon. But these remain sterile and dead unless the love of fame, or the no less noble desire to be useful, brings it into action. It then produces an union of ideas, images, sentiments and feeling, to which is given the name of genius—talent.

Having then well weighed the quantity and species of the objects gathered in the memory, it is necessary to examine what is the leading passion or natural bent of the mind before we determine upon any class of study. The multiplicity of various desires produces only littleness in our tastes; we are impassioned in our feelings, only when we are moved by one great leading purpose, to which all other notions and actions are subordinate. A strong passion is formed by the concentration and pre-eminence of one pursuit above all others.

To ascertain the force of that passion, if it be the love for distinction or the desire to be useful, it is sufficient to examine the degree of enthusiasm that we entertain for great men. Early youth, which is most susceptible of intense feeling, is also most susceptible of this enthusiasm; and it has then a most exact thermometer of its love for glory. It has not then motives to depreciate the merits and talents of others, for it hopes, that one day others will esteem in them that, which they esteem in others.

When once the degree of passion for glory is well understood, we may choose any pursuit most congenial to our taste. Every choice is good, if in any kind or sort we have the force of intense

desire proportionate to the difficulties to be overcome. It is most difficult to excel in a pursuit in which eminent men have already flourished and carried it near perfection. To distinguish ourselves, we must be capable of the highest exertions. He, who feels himself unequal to overcome great rivals, must avoid the paths already trod by them and full of their trophies; let him go by other ways, and he will find new regions to explore and cultivate.

A man, to render himself excellent in a class of knowledge, must not distract his attention by a multitude of trifling occupations; he must concentrate it entirely upon the ideas and objects immediately connected with the pursuit. But he must not *too* scrupulously act up to this principle. It is impossible to be profound in any subject, without being somewhat acquainted with other branches analogous to the one cultivated. We must dwell firmly and securely for some time upon the principles of the sciences, in order to consider the universal concatenation, which unites all the ideas of men under one general principle or law. This study gives much strength and greater extension to the intellect; but it is only preliminary and elementary. The attention must be mainly fixed upon the one particular pursuit.

If a sculptor studies politics and statuary, he runs the risk of failing in both.

A general acquaintance with literature is useful to the Architect, on account of the necessity he will frequently have of explaining his ideas by words and writing. To accomplish this with method, clearness, facility, and even brilliancy, is a desirable, but not a common, attainment.

Vitruvius does not suggest to the Architect the gift of oratory, thinking perhaps that the eloquence of the Architect consists rather in his works than in his words. In fact, Plutarch relates of two Architects, who offered themselves to the people of Athens in order to gain the superintendence or execution of some public works, that one of them, more expert than the other in the art of speaking, enchanted the Athenians by the brilliancy of his address. The other having remained silent at last said, "I, sirs, will do what he has said."

The study of *History* is valuable to the Architect, as recommended by Vitruvius; for if he be ignorant of it, how can he be consistent in the adoption of this or that class of art? How can he avoid anachronisms? How can he know whether the style be adapted for the purpose he intends it? The knowledge of history can

alone acquaint him with the proprieties, which have given rise to any peculiar class of design. The political institutions of a people, the predilections of rulers, the pursuits of the various classes, can alone explain the origin of the leading characteristics, which reign in any nation, province or city. The Egyptians, the Greeks, the Romans, the nations of the middle ages, have had their architecture influenced by particular physical and social circumstances.

Biography is a most attractive and, from its moral influence upon the mind, a very important branch of history. It teaches us the course, by which great men have attained to eminence. It unveils some of the arts, by which incompetent men have acquired a passing reputation. It shows the trials, through which most must pass, ere they may hope to excel. It marks the influence, which our art has had through all periods and among all nations. It hands down to us the noble and high-minded characters of those, who have graced our profession; the generous sacrifices of which they have been capable; their forbearance and disregard of low motives; their disinterestedness. Michael Angelo, in order to preserve his independence, declined the stipend attached to his appointment as architect of St. Peter's. And one

of the Florentine architects, being sent by the Grand Duke of Tuscany to Naples, where he executed some fine works for the King, declined any gratuity, saying that he had a generous prince by whose liberality he was already amply rewarded. The King would not be denied, and earnestly begged him to name any object he would like. " Give me then," said he, " that antique statue, that I may present it to my prince, as a gift worthy of his acceptance and a suitable mark of my affectionate attachment to a generous master." Let me refer you to Milizia's Lives of the Architects, translated by Mrs. Cressy, and believe me, that you will always rise from the perusal of those well-written memoirs with a greater love for your profession, a nobler passion for glory, a greater disregard of gain, and in fact a better man.

Thomas Carlyle in his opening lecture on heroes, hero worship, and heroic in history, has the following words: " We have undertaken to discourse here for a little on great men; their manner of appearance in our world's business; how they have shaped themselves in the world's history; what ideas men formed of them; what work they did.

" A large topic, indeed an illimitable one, wide

as *Universal history*; for, as I take it, Universal history,—the history of what man has accomplished in this world,—is at bottom the history of great men who have worked here. They were the leaders of men these great ones; the modellers, patterns, and in a wide sense creators of whatsoever the general mass of men contrived to do or to attain. All things, that we see standing accomplished in the world, are properly the outer material result, the practical realization and embodiment of thoughts, that dwelt in the great men, sent into the world: the soul of the whole world's history, it may justly be considered, were the history of these.

"One comfort is, that great men, taken up in any way, are profitable company. We cannot look however imperfectly upon a great man without gaining something from him. He is the living light fountain, which it is good and pleasant to be near. The light, which enlightens, which has enlightened the darkness of the world. And this not as a kindred lamp only, but rather as a material luminary, shining by the gift of Heaven; a flowing light fountain, as I say, of native original insight, of manhood and heroic nobleness; in whose radiance all souls feel that it is well with them."

The Mathematics, pure and mixed, are an essential part of the Architect's education. He has as much to do with figures as with lines; and at once to protect his employer from any want of foresight or fraud, it is necessary for him to be a ready calculator. It is one of the morals of architecture, that the Architect should never lead his employer into an useless expense; nor into one, which his means would not enable him to afford. It is a breach of integrity, which nothing can render excusable. Vitruvius records a wise law of the Ephesians. When an architect was employed upon a public work, he was required to declare the amount it would cost, and his goods were made over to the State. If the work cost one-fourth more than his estimate, it was allowed —if it were less, he was loaded with honors. But, if the expenditure exceeded the prescribed limits, his property was sacrificed to make good the deficiency. It is said that Vanvitelli, having exceeded his estimate in a public work connected with the execution of one of the fountains of Rome, was mulcted in the sum of 5000 crowns.

Mathematics have been much disregarded in the profession, and although we have two architects living, Messrs. Ware and Gwilt, who have written profound works on this branch; yet

generally it is much neglected, and thus there are very few qualified to investigate the mathematical principles, which govern the laws of construction.

Geometry is an indispensable part of the Architect's study. No man can be ready in design, or in the working out his conception, who is not familiar with all the aids to be derived from this requisite branch of science. It is not only essential in the numerous details, but also in setting out the work and in the mechanical processes connected with the execution; and, as Milizia truly observes, for the all-important doctrine of the laws of proportion.

Mechanics are another branch, without which the Architect is incompetent for any great and important work. The laws of thrust and resistance, weights and supports—the effects of arches and vaults—machinery, scaffolding, centering, come under this head: and, if he be deficient in it, he will not be able to command the respect, confidence and attention of the workmen, who are quick to find out any points, in which the Architect may not be well-prepared and they the more expert.

Perspective and Optics demand considerable attention on the part of the Architect. I refer not merely to linear perspective; but to that thorough

knowledge of the effects, which his edifice as a whole, or the parts as subsidiary, will have in execution. I have already alluded, when treating of the subject of composition, to the principal feature and to the subordinate portions, which should maintain a due relation and form a striking harmonious whole. Unless therefore the Architect understands well Perspective and the laws of Optics, he cannot hope to maintain the proper gradation in his buildings, nor to give that proportion of breadth and height and projection, upon which depends the harmony that he seeks to produce. In a design everything is relative; and its cubical elements depend upon its proximity or remoteness in itself, or its contiguity or distance from other objects. By Perspective and Optics we are taught to estimate these respective values, and to foresee the influence, which the design in execution will produce on the mind of the beholder.

But the theory of Mathematics must be regulated by a good dose of Physics; for, after all, the laws of abstract science are limited by the physical qualities of the materials employed in construction.

Chemistry therefore is of great service. We should not seek to be a Faraday or a Graham;

but we must know enough of the general laws of Chemistry to make us acquainted with the greater or less value of stones and timber. It enables us to test those stones best calculated for limes; those most adapted to resist the action of the weather. It renders us familiar with the causes of decay in wood, and provides us with remedies to ensure its durability and to prevent the rot.

Geology opens to us a vast field of useful knowledge. It qualifies us to appreciate soils and their relative fitness for foundations. It shows us those most likely to retain damp, or to carry off the surface-waters. It displays the abundant materials, which the Architect may employ—those sands, useful for his mortar—those formations, best calculated for his lime—those strata richest in stone for his solid constructions—the slates to cover his roofs, the metals to give strength and compactness to his framing. The Architect should visit, whenever occasion presents itself, the various quarries of different sorts of stones. He should take memoranda of the strata, their thickness and several qualities. He should note the modes of quarrying, and the various appliances used by the several trades employed to prepare it for application to building. The forge of the smith, the banker of the mason, the

bench of the carpenter, should be familiar to him, as also the various tools and contrivances employed by the mechanic.

The Aspect or Position of a building in reference to the cardinal points is a very material consideration. The desirableness of this or that aspect for a house varies with the different parts of the kingdom and of the world, in which it may be placed; nay, upon the locality in which it may be situate. With us the southern aspect is essential to cheerfulness and comfort. In Italy the north will be preferred for its coolness. I have known many houses spoiled from a neglect of the precaution of providing a pleasant aspect. Again, the principal look-out should be towards the pleasure-ground, not with a court-yard, and care should be taken to command a view of a range of hills, a lofty mountain, a river, a church, or some such striking and prominent object, which may interest. The house should, if possible, not be near a public road, nor a burial-ground, a railroad, or canal for traffic.

The importance of an abundant supply of *Water*, and that of a good quality, is much insisted upon by Vitruvius, Alberti, Palladio, and all writers. The utmost inconvenience arises from any deficiency in this respect; and its distribution to

every part of a house, a palace or a public building, is essential to comfort and cleanliness. In case of fire also it should be so arranged, as to afford the means of promptly subduing the destructive element. Hence the necessity of some acquaintance with *Hydraulics*.

Is there one here present, who has not felt the influence, which *Ventilation* has upon the health? How many ingenious men are there, who have advanced schemes for remedying the defects in ill-ventilated buildings! Again, how utterly unfit are many of our theatres, our courts of justice, churches, and other places of public resort, for hearing distinctly the voices of the speakers—another fertile source of scheming and contriving! Who then will deny, that an Architect ought to be acquainted with the leading principles of *Acoustics*, in order to allow him to judge of the various systems, which are submitted to him for adoption? All these are important accessories; and he, who is not prepared to consider their effects upon the building he is about to erect, will find it deficient in many of those points, which are now-a-days not the caprice, nor the luxurious nor chance want of the employer, but the very elements of his comfort and social happiness. Without them the most splendid dwelling, or the

most magnificent public structure, may be uninhabitable and useless—a source of constant misery to the employer and of complaint to the Architect.

Let us now consider the *Architect* as an *Artist*; and here some will say in the first place, "Have I genius? and can I succeed without that divine inspiration, in the absence of which I must be a mere plodder in the profession?" Let every man consider, that the brilliant and stupendous productions of genius are the results of a rare combination of powers. "Let not him," to use the vivid idea, though not the exact words, of Rousseau in his Dictionary of Music, "who would possess genius ask what it is. Hast thou it, thou wilt feel it in thyself. If thou hast it not, thou wilt never know what are its sensations. If thou wishest to know, if some spark of the devouring fire animates you, fly to Rome, to Athens. See the Coliseum; the Pantheon; the Parthenon; the Theseum. If an overpowering sensation of awe, admiration and delight possess your mind at the contemplation of these stupendous ruins—if you seek to equal, nay to excel, these wondrous creations of the human mind, call up all the impressions and emotions they excite in your soul. Possess yourself with the same feelings,

as inspired the Architects of those times. Let a sense of glory animate you. Seize your pencil. Give full scope to your imagination. Invent, and let the glowing paper reflect the images, which shine with such brilliancy in your own sensations."

If thou hast not genius, you may yet reflect, that an honorable career is still open to you. Architecture is made for the convenience, as well as delight of man. If thou canst not astonish, thou mayst yet please, and erect edifices, which may unite convenience, comfort, and a certain degree of unity of design and propriety of detail, which may not offend, even if they do not delight.

True genius developes itself by the study of the productions of others, and by an investigation into those laws of nature in which result the beautiful and the sublime of material objects. Transfer these laws to your art. Let your interpretation of the principles of the graceful or the grand open to others new sources of pleasing thought, fresh images of proportion and fitness. But this comes not of itself. A laborious course of study and contemplation can alone regulate the unruly crude thoughts of the mind, and reduce its first impression to any degree of order. It sometimes cost Rousseau a day of painful study

to compose a page of his glowing descriptions, which seem so easy and so flowing. The vivid pictures of Byron's poems were frequently the result of many painful strivings; and the fervid eloquence of a Burke and a Canning owed its force and power to previous laborious thought. But there are materials of expression, of which the Architect must first render himself master, ere he can hope to design well. He must draw with ease, and his well-trained hand must have the power to record with rapidity, precision and truth the fleeting thought. This cannot be acquired without years of unremitting practice. He must render his merely linear representations with accuracy and delicacy—he must be able to draw with fidelity any object, that presents itself; and know it thoroughly, not cursorily—or he will draw without precision or expression. The ornamentation of Greek, of Roman, of Gothic architecture, has each its distinctive peculiarity; and even each period of each style differs the one from the other. Attica and Ionia, Rome and its provinces, the Norman, the Lancet or the Florid Gothic of England, France and Germany, the Eastern of India and of China, has each its own impress and character; the knowledge of which can only be acquired by patient and intelligent analysis.

Our taste depends upon the models we chose for study. It is therefore of the utmost consequence to select those, which should suggest pure first principles and produce a fixed impression of correctness in our sensations. The moderns labor under the disadvantage of having continually before their eyes the bad examples of taste, which have been erected in the most unfortunate periods of the art. The ancients* in this particular

* The reverence for antiquity is to be no blind passion, as some suppose it to be. Is it not a respect for the productions of thinking reasoning minds—of great men, who, having certain requirements to fulfil, pursued a train of laborious thought, studied nature herself for sources of inspiration, and felt that they had to realize the wants of well-informed and highly-gifted men? It was no wild caprice or loose imagining, which planned the Parthenon and designed the Coliseum or Pantheon. It was a grave people, who conceived and executed the overwhelming and awful edifices within the sacred precinct of Carnac and Lugsor. Were not these independent minds? Were these servile imitators? But did they create these at once from their own resources, or, as the phrase now is, *from common sense*, a term identical with presumptuous ignorance? These great men studied the productions of previous periods, well weighed all their own wants, and hence resulted works, that have commanded the respect of every succeeding age. In fact without a knowledge of the classic monuments of antiquity, no one can have other than an imperfect, faint image of Architecture. Egypt and Greece had an existence peculiar to themselves. Independently of intrinsic beauty, their art had the great taste of perfection—unity—simplicity —appropriateness. In studying the fine productions of the

were more privileged than we. They had to begin from the very commencement, and their primitive wants suggested simple means to supply them. Thus art in Egypt may be seen in its first step—massive, grand, magnificent, and imposing—yielding attention to the more important requisites alone in order to produce effect. Having attained this, in course of time a want of further gratification for the senses introduced the minor details of sculpture and painting; so that in Greece, where an exquisite susceptibility for what was captivating to the taste reigned in a high degree, we find the utmost refinement and delicacy; a departure from which, in search of novelty unattended by the same refinement, gave rise to the monuments of Rome. These, however grand and impressive, still offer to the eye and judgment defects we could wish to see corrected. Man then continued gradually to decline, and the taste became more vitiated during the darker ages of the Lower Empire. To this downfall of classic taste succeeded Gothic architecture, which brought into play, as we have already remarked

Greek and Egyptian minds, we do not acquire merely the proportions of a cap, a cornice or a column—but we intuitively impress our minds with noble and sublime principles; and by the contemplation of simple and grand edifices receive impressions, which are imperishable.

in previous lectures, new laws and rules of its own. It set aside the principles of a foreign conception, as it were, and established for itself a less arbitrary and less strict limitation. It seized and canonized into beauties the very defects of classic art, clothed it in a new garb, and gave a scope to fancy. Thus unrestricted, it realized those stupendous and delightful creations, of which the Christian world has such just reason to be proud —a new and fruitful school of art and science.

Gothic Architecture flourished during four centuries; but yielded at length to the new direction given to men's minds by the re-introduction of Greek and Latin literature. The revival of classic art, however, produced only very inferior edifices; the exceptions to which do not reach the standard of antiquity. All these last bad examples, in the sight of which we are born and bred, unhappily influence most materially our present taste: and this can only be corrected by visiting on the spot the monuments of the classic times. The student need not take all the dimensions of every minute part with the elaborate accuracy of a Stewart or a Deering; but he must draw them with a certain degree of precision, and take at all events their general measurements, in order to possess himself thoroughly of their

details, their proportions, and arrangement. When he has done this, he must complete the study by a contemplation of the whole as a monument: and he must reason in his own mind upon the causes of certain effects, and analyse the impressions made upon him.

Palladio studied admirably the monuments of Rome. He slightly sketched the general proportions and parts, and then restored the ruin to what he considered its original perfect state. I suppose therefore that the student, ere he does this, has thoroughly studied at home the orders and their proportions; and learned to measure accurately the parts of a building. It is not enough that the edifices of Greece and Rome have been correctly published by others. If the student wishes to know a building thoroughly, he must measure* it

* The style of those admirable restorations, which are produced by the French school of Architecture hold very much of the antique Roman, and may be called classical gleanings. They are generally made up of scraps from the ruins of those venerable edifices, and the pleasure they afford is derived from the propriety with which the selection is made. In such case the student must take care that every portion, every order, every detail introduced, be of the same æra, and authorized by the best examples. For if he should chance to introduce any combination of a later period, or any dissonance from the custom of the time, or should perchance not sufficiently chase from his mind the habits of modern years, he may fall into the most exceptionable solecism, and thus spoil the harmony which

himself. And the greater number he measures, the vaster will be his store of useful authorities and types to assist his invention and to guide his taste.

But to increase this store to a greater degree, and thus gain an inexhaustible fund, to which he may refer on any occasion, it is desirable that the Architect, at whatever stage it may be of his practice, should carry constantly with him a sketch-book. He should make a slight drawing of anything which may strike him as remarkable and worth remembering. His motto should be, *Nulla dies sine lineâ.* The very act of sketching an object will impress it upon his memory. But in addition to that result he will have a more exact notion of it, and if he should forget it, he has it upon record for future reference; and certainly he will thus acquire the habit of more exact observation. The sketches should be subsequently

alone constitutes the beauty of such compositions. How harsh to the classic eye the mixture of the purity of the Augustan age with the corruption of the Antoninian or the barbarism of Diocletian buildings! This shows how necessary in classic compositions is the analogy of every detail. And he, who proposes the attempt, has no alternative but to adopt those formed to his hand, and the great merit he will derive will be in accommodating each feature of the parts to the general effect of the whole. He may not produce any unexpected combinations, but those authorized by the severest rules: the merit of the artist will consist in the skill with which he combines the mechanism of the several portions.

arranged systematically in a larger blank book with a proper classification of subjects, and by this means he may ultimately possess a most interesting series of precedents, descriptions and authorities, whether in art or in the sciences connected with Architecture. He will thus have a collection, which will readily furnish ideas, that will appear to rise spontaneously; but which in fact will only be the fruit of these seeds, which he will as a student have so laboriously collected in his earlier years.

It is very necessary for the student to acquaint himself with the *Theory of Colors*, in order to know at once the common laws of contrast and harmony, which govern tints, and which will guide him unerringly in his selection. As much of the beauty of the internal parts of buildings depends upon the tones of color, which prevail, as upon the harmony of the architectural proportions and propriety of the details. There are none, who will not remember having received pleasurable as well as disagreeable sensations from the mode, in which the walls, the ceilings, the floors of an edifice may have been toned, and the selection of tints for the furniture. The finest monuments of Greece, the most elaborate details of Gothic architecture, were covered with color. How

important then is it for us to note every instance, in which we may meet with it in buildings! But it is also desirable, that the Architect be able to judge of those essential handmaidens to Architecture, Painting and Sculpture, her younger sisters, from whose assistance she may acquire so much interest, expression and fitness, in addition to the power which her monuments possess physically over the mind from their proportions, size, and the materials of which they may be built.

In ancient art a temple was considered the dwelling of the god, embellished and rendered eloquent by the sculptured illustrations of the allegories and history of the deity, who was worshiped. How considerable a portion of beauty, majesty and meaning, would not the Parthenon lose, stripped of its metopes, its friezes, and the splendid groups of its pediments! Vast and impressive, as is the portico of the Pantheon, how inferior must the impression be upon our minds to that, which the ancient Roman experienced; when the rich profusion of its sculptures in the tympanum, upon the apex and angles of its pediment, when the splendor of its vaulted bronze ceiling, the statues of Augustus, of Agrippa and other noble spirits, gave it life and animation,

instead of the solemn deadness of its present shorn state! The imagination is now obliged to create an image of its pristine greatness, in order to realise approximatively the idea of its original magnificence.

But Painting dwindles into mere furniture, as it were, if its production be limited to the size of a canvas and its extent be encircled by a gilt frame. Carry your imagination to the walls of the Vatican and to the interiors of Italian churches. Conceive the sides of a vast room rendered eloquent and instructive by the full-sized representation of the School of Athens, of the awful mysteries of the judgment-day, by the affecting incidents of a battle-field, or the enchanting groupings and attractive glow of the Aurora. This is real painting upon its proper scale. Imagine the pencil of the painter and the chisel of the sculptor called in to embellish worthily your architectural productions; and realise, if you can, the glorious combination of the three sister arts, each in its own sphere winning the admiration of the beholder, and together forming a glorious combination, as in St. Peter's at Rome. In France you may feel something of this; for our neighbours are more alive to the united powers of the three arts than we, and have car-

ried out the combination with considerable power in some of the buildings at Paris. But I cannot now allude to any building in England, in which the masterpieces of sculpture, painting and architecture find a common home, and form a magic circle of enchantment.

Let us hope, that the noble daring and brilliant imagination of the Architect, and the liberality of the nation, seconded by the genius of our painters and sculptors and the ingenuity of our manufacturers and artisans, will have their full scope in our new Houses of Parliament: and that an Englishman, some ten or twenty years hence, may be able to point to this grand mass of building, as irrefragable evidence, that British art can equal any of the masterpieces of foreign genius, if it only be afforded opportunity to display itself: despite our climate; despite our atmosphere; despite our social, our moral, and religious institutions; with which we have been reproached by foreign writers, as offering insuperable obstacles to our rising to any eminence in the cultivation of the arts of design.

There is another class of study essentially important to the young Architect, and that is *Practice*. He may have acquired all the principles, which govern science. He may have studied

monuments, learnt the rules of proportion, and made himself thoroughly acquainted with the whole sphere of art. But, unless he be also versed in the practical details, it would be dangerous to himself and fatal to his employer, if he undertook a building of any importance. He has a conscientious duty to perform: not only to design well, but to execute the work in the soundest manner and with the least cost. Young men, carried away by the enthusiasm to which the fascinating attraction of the art of drawing gives rise, find it irksome to enter into the details of construction, the cost of materials, measuring and valuation. But if an Architect wishes to possess all the means, by which he may realise his conceptions, he must go through this ordeal, he must visit and study works in progress: and when he becomes better acquainted with the subject, he will find a growing interest in the pursuit. There is no moment of his life, at which the true Architect ceases to study and acquire knowledge; and no source is too despicable for him to gain information. The laboring artisan has many mechanical contrivances, by which he may accomplish his task and execute his work. From him the Architect, whether as a student or as the more advanced practitioner, may learn much.

In fact we must not only be satisfied that a thing is done, but know how it is done; and eagerly avail ourselves of the knowledge of the workman. By not being ashamed of asking questions at any period of our career, we gain their respect and win their confidence. How many a young man is there, who leaves an office without any acquaintance with these departments of the profession! He commences business thus inadequately prepared. His very first commission involves him in inextricable difficulties. He is at the mercy of the builder, the workmen, and all employed. A sense of his ignorance in this respect preys on his mind. He resolves to devote his energies to make himself thoroughly versed in the practical details of construction, and he passes years and years devoted to this; and thus employs time, which, had he been better trained, could have been more beneficially and honorably appropriated. He had still to learn his profession!!

In fact there is a vast distance between the theorist and the man of experience. The one proceeds on the assumption, that all the facts are of a definite class and limited by certain circumstances: that the materials at hand are homogeneous throughout and of the best quality: that the workmanship is of the most perfect

description: that the season of performing the work is the most favorable: and that no contingency arises, which may not be anticipated. But too frequently the most irksome incidents may baffle the practical man at every step. The ignorance or inattention or absence of the assistant or superintendent may afford opportunity for the introduction of bad materials. The inefficiency, neglect or dishonesty of the artisan may render the work unsound, an unskilful foreman may render it insecure. The dishonesty of the quarryman may introduce a bad material, which the mason may not care to observe. A quantity of dead lime or cement may deprive the mortar of its cementitious quality. A shower of rain, a storm or a frost unforeseen, ill provided against, may produce serious evils. A sudden spring, an unknown cavity in the foundations, may cause a settlement. Such are some of the adverse incidents, that may arise and demand all the science, experience, the patient endurance and energy of the well-grounded Architect, to triumph over them all.

The Architect stands in a middle relation between the employer and the builder. He has duties towards both. He must be active, vigilant, shrewd; above all well-versed in his subject.

He must see, that the prices, at which the work is to be done, are reasonable. He must take care, that the materials are good, the workmanship sound. He must protect his employer from loss by fraud, by neglect, or carelessness. With regard to the builder, he must see that he is not oppressed by being required to do more than his contract specifies; that the payments to him be punctual, that fair allowances be made for casualties, and that he realise a just profit. His motive of action must be the consideration, that the first great end of his engagement is the unequivocal advantage of his employer, and not his own personal gain; to be unreservedly faithful to him, who has engaged his services.

There are many trying circumstances, which will arise in regard to the relations of the Architect to his employer. He is of course to consult his convenience, to adapt the building to his reasonable fancy, and above all to take care that it exceed not his circumstances. At the same time, when once the design is settled, he must not allow a meddling interference with the details, nor permit a man of fanciful ideas to force him to do what is contrary to good taste, and likely to compromise the character of the Architect: for he will in the end have to answer for every-

thing, that may be wrong. He must be firm, but also respectful; and being otherwise irreproachable will create a feeling of deference and consideration for his professional acquirements. We know, that we owe the Pavilion at Brighton and Buckingham Palace to the low taste of George the Fourth, who insisted upon his architects building according to his whims and fancies. The consequence has been, that they deservedly bear all the blame. Had they assumed a high-minded independence, and declined to undertake a work disreputable to their rank in the profession, it is possible that their firmness might have produced conviction on the mind of the Prince, and saved them from the obloquy, which they acquired. But let me not mislead you. If a certain fancy strikes your employer, it is your duty to endeavor to realise it, so that it may be done with good taste and evidence of skill. If not, rather abandon it than peril your fair name as an artist and man of science. You must respect yourself, or you will not be respected: for the moment you disregard your own reputation, you must not consider that any one else will hold it in much estimation.

Vitruvius tells us that the Architect must not seek for employment; but wait till he is sought.

That is carrying delicacy to a fancied pitch of refinement, which is now impracticable. But he must exercise a certain reserve, at the same time that he is justified in availing himself of every opportunity of making his talents known: and, if the proper occasion present itself, of interesting his friends in his favor to promote his interests. He must not stay at home, and expect that by a species of intuition the world is to know how capable he is of undertaking a great work, and how advantageous it would be to employ him. But in seeking for employment he must use the delicacy of a sensitive and refined mind; and utterly abhor and avoid any underhand unworthy means of success. He must not urge his pretensions, unless justified by the occasion or authorized by any accidental circumstance: and his conduct must be noble, open and generous. He must never attempt to supplant a professional brother: nor seek, by foregoing a portion of his fair professional remuneration, to underbid him. He must never volunteer an opinion to the disparagement of another architect. But at the same time, if called in for his judgment, he must frankly and fearlessly declare the truth, whatever may be the consequence to himself, or however it may affect another. But it will be well to

extenuate an error or imperfection, rather than to exaggerate: and to suggest a remedy, rather than to leave a defect to be supposed to be irreparable.

If a genuine love of his profession animates the Architect, he will throw his whole soul into whatever he undertakes: for there is in the fine arts a peculiar source of inspiration and motive to exertion, and that is the love of the beautiful. He, who has not that within him, cannot be a true Architect. The artist has an exquisite perception of all the forms of beauty in the animal, vegetable, or mineral creation. Form—color—proportion—have in his mind an innate chord, which responds to the harmony and beauty of nature. But he also has the power to express them himself, and to render these effects in his picture, his statue or his building. The very operation of invention—the delight of witnessing his design assume a congruous form, and then to see it developed and realized in execution, is of itself a sufficient reward for all his anxiety and labor of thought. He will not, therefore, stop to consider, whether the matter will repay him for his trouble; his first great aim will be to do it thoroughly, and consistently with his own character and reputation. A stern sense of

right and wrong, a love of high honor will lead him on. Self-love is a general passion: ambition for the esteem and respect of others is to a degree no less universal. But upon the due combination of these, and upon the energy, with which they act upon our system, depends the sentiment of honor, the love of fame. "The basis of the honor which we render to others," says Milizia, "is utility—utility decides always upon our esteem —and the man, who can be the most useful to us, is the one, whom we most honor." It is a general sentiment of almost all periods and of all countries, that the man without honor is the one, who is least capable of being useful to his fellow-man. Marcellus, emphatically called the Sword of Rome, five times consul and the conqueror of Syracuse, who wept the death of Archimedes, and erected a tomb to his memory, built a temple to Honor and Virtue, connected the one with the other; but so arranged, that it was necessary to pass through that of Virtue in order to reach the one sacred to Honor. In fact virtue is the only true path to honor. In what then essentially consists virtue? The full development of our moral and intellectual faculties combined—the acquisition of knowledge by painstaking, unwearied study—the application of that knowledge

with skill, intelligence, forethought, taste and integrity. Genius is truly a fire divine—an inexplicable creative faculty, which if not restrained, directed, instructed; will run a wild mad course of useless brilliancy. But perseverance—an unchanging desire to excel—a patient acquisitiveness of knowledge—will to the possessor produce solid results, and lead him to distinction. He may not be so brilliant, as the man of genius; he may not so much surprise; nor command, it may be, such moments of exalted ideas: but he may confer more sterling benefits on mankind in general, and rank among the foremost in the page of history. There is a wreath for every one—let then each stretch forth with ardor to seize the prize, and remember, that he possesses within himself the powers to command success.

In the course of this series I have had occasion to treat upon various branches of knowledge and to call your attention to others. You will, I hope, have felt satisfied, that I have not suggested any class of science, as necessary or useful for you to acquire, the importance of which has not been amply proved during these lectures. You will not feel disposed, I trust, as may some of our superficial practitioners, to regard as useless,

what may not have an immediate and direct application. For my part I cannot consent to restrict the pursuits, the acquirements, the knowledge, the talents of an Architect to the narrowed limits of the immediate branches of professional science. This may do for the mere mechanic—but by such a rule the Architect, as an artist and a man of science, cannot, ought not to be measured.—Regard him as a man of science. Is his attention to be merely turned to the choice of this or that timber, the selection of this or that metal or stone? Would I not rather let his mind be more amply developed by diving into the mysteries, which regulate matter in general, and by observing the geological structure of the globe and the relative value of each stratum? Shall he not with the aid of Chemistry deeply study the stupendous influence of heat, upon which in its largest scope depends the very existence of this sphere? And in the same manner through every division of Physics. Shall he as an artist limit, as some have done, his knowledge of Architecture to a delineation of the classic orders, and not rather master all the styles of all ages and countries; profoundly investigate the elements of beauty, fitness and proportion in each; and perchance create a new style or design

a new order? Shall he not, as I have already said, appreciate the brilliant aids, which sculpture and painting afford to buildings; and by the study of color produce graceful combinations of harmonious tints, in the adoption of various-toned marbles and the delightful illusions of stained glass?

I have frequently had occasion to mention to you the respected name of Vitruvius. I will show you, that the image I have formed of what an Architect should be is not peculiar nor exaggerated. I may quote an Alberti, a Palladio, a Milizia, a De Quincy, in support of my views: but I prefer recurring to the old Roman, and showing you, that my estimation of an Architect's qualification is 1800 years old. The first chapter of the first book of Vitruvius on Architecture is devoted to the consideration of what Architecture is, and what should be the acquirements of the Architect:—

"Architecture is a science arising out of many other sciences, and adorned with much and varied learning; by the help of which a judgment is formed of those works, which are the result of other arts. Practice and theory are its parents. Practice is the frequent and continued contemplation of the mode of executing any given work,

or of the mere operation of the hands, for the conversion of the material in the best and readiest way. Theory is the result of that reasoning, which demonstrates and explains how the material wrought has been converted so as to answer the end proposed. Wherefore the mere practical architect is not able to assign sufficient reasons for the forms he adopts; and the theoretic architect also fails, grasping the shadow instead of the substance. He, who is theoretical as well as practical, is therefore doubly armed; able not only to prove the propriety of his design, but equally so to carry it into execution.

"An Architect should be ingenious, and apt in the acquisition of knowledge. Deficient in either of these qualities, he cannot be a perfect master. He should be a good writer, a skilful draftsman, versed in geometry and optics, expert at figures, acquainted with history, informed on the principles of natural and moral philosophy, somewhat of a musician, not ignorant of the sciences both of law and physic, nor of the motions, laws, and relations of the heavenly bodies to each other. By means of the first-named acquirement, he is to commit to writing his observations and experience, in order to assist his memory.

"Moral philosophy will teach the Architect to

be above meanness in his dealings, and to avoid arrogance; it will make him just, compliant and faithful to his employer. And, what is of the highest importance, it will prevent avarice gaining an ascendency over him; for he should not be occupied with the thoughts of filling his coffers, nor with the desire of grasping everything in the shape of gain, but, by the gravity of his manners, and a good character, should be careful to preserve his dignity. In these respects we see the importance of moral philosophy; for such are her precepts.

"Architecture being founded upon and adorned with so many different sciences, those, who have not from their early youth gradually climbed up to the summit, cannot, without presumption, call themselves masters of it. Perhaps to the uninformed it may appear unaccountable, that a man should be able to retain in his memory such a variety of learning; but the close alliance of the different branches of science with each other will explain the difficulty. For, as a body is composed of various concordant members, so does the whole circle of learning consist in one harmonious system. Wherefore those, who from an early age are initiated in the different branches of learning, have a facility in acquiring

some knowledge of all, from their common connexion with each other. On this account Pythius, one of the ancients, architect of the most noble temple of Minerva at Priene, says, in his commentaries, that an Architect should have that perfect knowledge of each art and science, which is not even acquired by the professors of any one in particular, who have had every opportunity of improving themselves in it. This, however, cannot be necessary; for how can it be expected that an Architect should equal Aristarchus as a grammarian? yet should he not be ignorant of grammar. In music, though it be evident he need not equal Aristoxenus, yet he should know something of it. Though he need not excel, as Apelles, in painting, nor as Myron or Polycletus, in sculpture, yet he should have attained some proficiency in these arts. Thus also, in other sciences, it is not important that pre-eminence in each be gained, but he must not, however, be ignorant of their general principles. For surely in such a variety of matters, it cannot be supposed, that the same person can arrive at excellence in all; since to be aware of their several niceties and bearings, cannot fall within his power. We see how few of those, who profess a particular art arrive at perfection in it, so as to distinguish

themselves; hence, if but few of those, practising an individual art, obtain lasting fame, how should the Architect, who is required to have a knowledge of so many, be deficient in none of them, and even excel those, who have professed any one exclusively? Wherefore Pythius seems to have been in error, forgetting that art consists in practice and theory.

"Those unto whom nature has been so bountiful, that they are at once geometricians, astronomers, musicians, and skilled in many other arts, go beyond what is required of the Architect, and may be properly called mathematicians, in the extended sense of that word. Men so gifted, discriminate acutely, and are rarely met with.

"Since, therefore, few men are thus gifted, and yet it is required of the Architect to be generally well-informed, it is manifest he cannot hope to excel in each art." So far Vitruvius.

It is for the Architect or Engineer further to remember, that in the pursuit of his profession he must not be content with merely qualifying himself for the exercise of it, as the mechanic or the tradesman may regard his avocation. He should prepare himself for the society and connexions, to which his engagements will necessarily introduce him. It must be his endeavour to fit

himself by appropriate accomplishments for intercourse with those who will employ him. He will be called upon to be associated with gentlemen of rank, fortune and influence, with the nobles of the land, and occasionally perhaps will be admitted into the presence of the Sovereign. He will have to reside as Architect for days, nay perhaps weeks together, at the country seats, which he may be called upon to alter or rebuild, in society of the most brilliant class. Is it not then proper, that he should maintain his intellectual position, as a man of general knowledge in literature and science, as well as that in architecture? The higher classes have most of them a highly-wrought education, and their very intercourse with the world developes their faculties in a very superior manner, even when early instruction may have been neglected. It is important, therefore, that the professional man should not limit his attention to the department of knowledge, which he may profess. He must refine his literary taste; enlarge his acquaintance with history; and make himself master of the topics of the day. This must proceed with the early studies of his art, and he must occupy the many leisure spare hours he has, by reading in that class, which will relieve the tedium of close

application to the dry details of professional practice. His ambition must be to be the agreeable, intelligent companion, nay the valued friend, of those, whose interests he may be called upon to protect, and whose property he may be required to improve by the results of his skill and taste. He must strive to be considered as something more than the mere necessity of the moment, disregarded and thrown off, when the time for his employment shall have passed.

We have now, Gentlemen, for two years in this room pursued together the investigation of the different branches of our subject. I have endeavored with an earnest zeal to open to you the vast and attractive studies of ancient art and of modern science. It is impossible in a course of lectures, however elaborated, thoroughly to teach any subject. The Professor can only slightly treat upon its different branches, lay down the general principles, and point out the course of study, which the Student must pursue in his own closet, in order to investigate and learn fully the laws and practice of any pursuit. I trust and expect, that you will not have rested satisfied with the instruction I may have communicated; but that you will have consulted other authorities, and made yourself master of

all the bearings of each subject—or at least be prepared so to do.

In carrying out such a course you may easily imagine the eager desire, which has animated me to fulfil your expectation, and to acquire your confidence. The midnight lamp in the quiet of my own study has constantly witnessed my efforts to prepare worthily the noble objects, which I have had to bring before your notice. I have disregarded the labor and spared no cost. I am aware, that some of the divisions will in after-years, should I be spared and meet with the like encouragement, derive much advantage from maturer study. I seek each year to illustrate more fully some of the topics and to enter upon others, which I contemplate, but which circumstances have compelled me for the present to defer. But, Gentlemen, if it have been with me a work of labor and research, it has also been one of intellectual profit and delight. I trust that *you* may not look back upon it with regret, nor think those hours uselessly employed, which you have passed in the Class-room. I shall ever remember with satisfaction the attention I have experienced from every one of you, and I trust that in those years, when you are treading the path of fame and are acquiring fresh laurels to grace your

brows, a stray thought may now and then pass through your minds, recalling these hours and your fellow-students, and the memory of your teacher and friend, who has sought, he hopes not in vain, to communicate to you some portion of knowledge. It has been his endeavor to arouse you to a consciousness of your own powers, and to impart to you that thirst for glory, that high-mindedness and deep sense of honor in the practice of our noble profession, which it has been his aim throughout a period of one-third of a century to realise in himself.

THE END.

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RED LION COURT, FLEET STREET.

ERRATUM. Page 52.

Maxim CLV. The third section of a cast-iron beam on the first line should have been  , and the section on the fourth line should have been  .

Other Works by the same Author.

ANTIQUITIES OF ATHENS and other Places in Greece and Sicily, supplementary to the Antiquities of Athens by Stuart and Revett. fol. Pl. London, 1830.

The Temple of Apollo Epicurus at Bassæ near Phigalia, the Gate of Mycenæ, the Treasury of Atreus. An Essay on the Form, Arrangement, and Construction of the Greek Theatre. By T. L. DONALDSON.

POMPEII, illustrated with Picturesque Views, engraved by C. H. Cooke from the original Drawings of Col. Cockburn, and with plans and details of the Public and Domestic Edifices, including the recent excavations, with descriptive letter-press to each Plate. By T. L. DONALDSON. London, 1827.

SELECTION OF ORNAMENTAL SCULPTURES, consisting of Vases, Altars, Candelabra and Tripods from the Museum of the Louvre, Paris. Engraved by H. Moses, with descriptions by T. L. DONALDSON. 4to. London, 1828.

TWENTY-FOUR SELECT VIEWS IN ITALY, Engraved under the direction of W. B. COOKE, with Descriptions to each View by T. L. DONALDSON. 4to. London, 1833.

A COLLECTION OF THE MOST APPROVED EXAMPLES OF DOORWAYS from Ancient and Modern Buildings in Greece and Italy, expressly measured and delineated for this work, preceded by an Essay on the Usages of the Ancients respecting Doorways, a new translation of the chapter of Vitruvius on the subject, with the original text taken from an ancient and valuable MS. in the British Museum; and copious Descriptions of the Plates by T. L. DONALDSON. 57 Plates, 4to. London, 1833, 1836.

A REVIEW OF THE PROFESSION or LIFE OF SIR JOHN SOANE, Architect, deceased the 20th January, 1837; with some remarks on his genius and productions, read at the first subsequent ordinary Meeting of the Institute of British Architects held on Monday 6th February, 1837. By T. L. DONALDSON. 8vo. London, 1837.

A LETTER TO H.R.H. THE DUKE OF SUSSEX, with a Plan for the promotion of Art, Science and Literature, by the moderate but effectual assistance of Government. By T. L. DONALDSON. 8vo. London, 1838.

HOW TO OBSERVE ARCHITECTURE; or Questions upon various subjects connected therewith, suggested for the direction of Correspondents and Travellers, and for the purpose of eliciting uniformity of observation and intelligence in their communications to the Institute of British Architects; drawn up at the request of the Council by T. L. DONALDSON, Honorary Secretary of Foreign Correspondence. 2nd edition. 8vo. London, 1842.

PRELIMINARY DISCOURSE pronounced before the University College of London, upon the commencement of a Series of Lectures on Architecture. By T. L. DONALDSON. 8vo. London, 1842.

UNIVERSITY COLLEGE, LONDON.

DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE.

THE Education in the department of Civil Engineering and Architecture will be conducted by the Professors of *Mathematics, Natural Philosophy, Chemistry, Practical Chemistry, Civil Engineering, Architecture, Mechanical Principles of Engineering, and Descriptive Machinery,* by the Lecturer on *Geology,* and the Teacher of *Drawing.*

THE COURSES RECOMMENDED ARE:

For the FIRST YEAR, *Junior Mathematics, Natural Philosophy (Experimental Course), Inorganic Chemistry, Geology, Drawing.*

For the SECOND YEAR, *Senior Mathematics, Natural Philosophy (Mathematical Course), Civil Engineering, Architecture, Descriptive Machinery, Geology, Drawing.*

For the THIRD YEAR, *Civil Engineering, Architecture, Mechanical Principles of Engineering, Organic Chemistry, Drawing.*

If the Student be sufficiently advanced in the subjects of any of the above-mentioned classes he may omit the attendance on them, and pursue the other branches of his studies in their higher departments.

The regulations respecting Certificates of Studentship required by the University of London from Candidates for Degrees, and the Annual Examinations for Prizes, are set forth in the General Prospectus of the Faculty of Arts. The proficiency and progress of pupils will be tested by the Annual Examinations; and such pupils as, after having passed such Examinations, shall, for regularity of attendance and for satisfactory proficiency in all the branches of study enumerated in the preceding Curriculum, obtain the approbation and testimonials of the respective Professors, shall receive a Diploma or Certificate, testifying the same, from the College.

It is not intended by the College that the School of Civil Engineering and Architecture should supersede the necessity of the pupil completing his studies in the office of a Civil Engineer or Architect; it is considered, however, that attendance on the Courses above-mentioned, in addition to the usual acquirements and experience attained in the office of a master, will enable him to enter with superior qualifications on his career of professional practice.

While the above would be the Course which the College undertakes to give, it is by no means to be understood that it includes all the studies necessary to qualify a Student for either of the professions of Civil Engineer or Architect: it may rather be considered as the outline of what is absolutely indispensable. It is therefore recommended that the several Professors should be consulted as to the proper amplification of their respective Courses in special instances; and further, it is suggested that the study and acquirement of modern languages should be steadily pursued, so far as to enable the student to read the many valuable elementary and practical works on Civil Engineering and Architecture published on the continent. A facility of speaking those languages is further desirable, as members of both these professions are continually called on to examine into and to report and advise upon, and even to execute, works in foreign countries. A thorough acquaintance with the French, German and Italian languages is requisite for the Engineer and Architect.

MATHEMATICS.—Professor DE MORGAN.

JUNIOR CLASS.—*Lower Division,* Tuesday, Thursday, and Saturday, from 9 to 10¼.
Higher Division, Monday, Wednesday, and Friday, from 9 to 10¼.

SENIOR CLASS.—*Lower Division,* Tuesday and Thursday, from 3 to 4¼; and Saturday, 11¼ to 12½.
Higher Division, Monday, Wednesday, and Friday, from 3 to 4¼.

Fee for each Class, 7*l.*

The Lower Division of the Junior Class is intended for those Pupils who possess very

little previous acquirement. The subjects read are, the First Four Books of Euclid, Arithmetic, and the Arithmetical Theory of Proportion; the Sixth Book of Euclid, so far as the same can be studied with an Arithmetical Theory of Proportion; the First Book of Solid Geometry in Lardner's Euclid; Algebra arithmetically considered, as far as equations of the first and second degrees.

The Higher Division of the Junior Class is intended for those whose previous reading will enable them to begin the Fifth Book of Euclid. The Subjects read are the Fifth and Sixth Books of Euclid; the First Book of Solid Geometry in Lardner's Euclid; a Review of the Principles and Operations of Arithmetic; Algebra; Plane Trigonometry; and, if time permit, the Conic Sections geometrically. The extent to which each subject is pursued depends upon the progress of the Class.

The Lower Division of the Senior Class will comprehend those who have (either in the College or elsewhere) passed through the Subjects of the preceding Class. The Subjects here read are, Spherical Trigonometry; Conic Sections; application of Algebra to Geometry; higher parts of Algebra; Differential and Integral Calculus. The Subjects read in the Higher Division will consist of Developments of those which have been read in the preceding Division, to a greater or less extent, according to the acquirements of the Pupils.

It is to be understood that any pupil has the option of attending more than one Division in the same Session without any additional fee.

The interval between the two Lectures on Saturday morning (from 10¼ to 11¼) will be devoted to the explanation of such difficulties as occur in the reading of the Pupils. And the Professor is very desirous that the Pupils of every Division should avail themselves of this opportunity.

The Professor reminds all who enter his Class, that nothing can be more erroneous than the impression that much can be done by merely attending the Lectures. Unless such attendance be accompanied by regular Study of the Books recommended, and attention to the Exercises given out in the Class-room, he cannot guarantee that any pupil shall find himself able to keep up with the Class.

The Courses above announced, as given in the Higher Junior and Lower Senior Classes of the Faculty of Arts, are amply sufficient for the ordinary purposes of the future Engineer. In the former are taught, among other things, the higher operations of Arithmetical Computation; the nature and use of Logarithms; the ordinary rules of Mensuration and Trigonometry; and the language and elementary operations of Algebra: in the latter, the rules of Spherical Trigonometry; the Conic Sections; and the principles of the Differential and Integral Calculus, to an extent which contains the application of these sciences to the higher parts of Mensuration. For those who would learn more of the Mathematics, in the Higher Division of the Senior Class are taught the Subjects which all must learn who wish to become analysts, whether for Engineering or any other pursuit.

NATURAL PHILOSOPHY AND ASTRONOMY.

Professor Potter, A.M., late Fellow of Queen's College, Cambridge.

Experimental and Descriptive Course.

Monday, Wednesday, and Friday, from 4¾ to 5¾ P.M. Fee, 6*l*.

Subjects.—I. Mechanical Sciences. *Statics*: on the nature of Statical Forces and the modes of measuring them; the composition and resolution of Forces; on their tendency to produce rotatory motion: on the finding of the Centre of Gravity of Bodies, and its properties; the principle of Virtual velocities; on the Elementary Machines; on the effects of Friction in statical problems. These lectures are illustrated by many experiments. *Dynamics*: the measure of Forces when they produce Motion—on bodies impinging; on bodies moving by the action of accelerating and retarding forces; on the lunar and planetary motions, and tides; on the constrained motion of bodies; on the Dynamical principles; on the moment of Inertia in rotating bodies; on oscillation; on percussion; on motion in a resisting medium, &c. With many experimental proofs and illustrations. *Hydrostatics*: the properties of fluids; their transmission of pressure; their pressure on surfaces; on floating bodies; on elastic fluids; on heat; on the Hydrostatical Instruments,—the Thermometer, the Barometer, Bramah's Press, the Air-Pump, the Steam-Engine, &c. &c. The experimental proofs very numerous. *Hydrodynamics*: the form of Jets of Fluids; the construction of Water-wheels; the properties of diverging and converging streams of air, &c. II. Acoustics. III. Optics, including the properties of ordi-

nary and Polarized Light; Optical Instruments. IV. Electricity, comprising Electrostatics, Electro-dynamics, Electro-magnetism, Thermo-Electricity, &c. V. Astronomy: Astronomical Instruments; Methods of observing; Phenomena of the Universe.

In the above Course continual use is made of the apparatus in the Natural Philosophy Museum of the College.

Junior Mathematical Class.

Tuesday, Thursday, and Saturday, from 9 to 10 A.M. Fee, 7*l.*

A previous knowledge of Euclid, Books I. to IV. and VI., and the more elementary parts of Algebra and Plane Trigonometry, is requisite for Students attending this Class.

The Subjects:—Statics, Dynamics, Hydrostatics, Hydrodynamics, the first three sections of Newton's Principia, Optics and Astronomy. The most approved University treatises are adopted as text-books in these sciences, and the Class is conducted through them as high as their Mathematical attainments permit.

Senior Mathematical Class.

Monday, Wednesday, and Friday, 9 to 10 A.M. Fee, 7*l.*

A previous knowledge of Geometry, Algebra, Trigonometry, Conic Sections, and the more elementary parts of the Differential Calculus, is requisite for the Students of this Class.

The Subjects:—Analytical Statics and Dynamics; the Theory of Fluids, comprehending the higher Hydrostatics and Hydrodynamics, with the Theory of Sound; Optics, to second approximations, oblique and excentrical pencils of light; and generally the higher propositions beyond the reading of the Junior Class: Astronomy; by means of Spherical Trigonometry, the propositions in use in observatories, and in the applications of Astronomical observations to practical uses; the Theory of Charts and of Dialling. For this Class the text-books used are the higher treatises used in University education.

CHEMISTRY.—Professor Graham.

Inorganic Chemistry. (First Year.)

Daily, from 11 to 12. From October to February. Fee, 4*l.*

The subjects of this Course will be discussed in the following order:—

1. Heat;—its influence upon the physical condition of matter, and the laws of its transmission, with the useful applications of our knowledge to domestic economy and the arts.
2. Light, chiefly in its chemical relations.
3. History and properties of the thirteen non-metallic elements, such as Oxygen, Hydrogen, Carbon, &c.; of their mixtures and combinations, such as Air, Water, Sulphuric Acid, Ammonia, Coal-Gas, &c.
4. The forty-two metallic elements, such as Potassium, Iron, &c.; their ores, oxides, salts, and other combinations.

The subjects of the Lectures will be fully illustrated by experiments, specimens, diagrams, and models.

In discussing chemical laws and the properties of bodies, their bearing upon the economy of nature, and their useful applications in the arts will be particularly insisted upon. Hence it will be a prominent object of the Course to develope the principles of important chemical manufactures, such as glass-making, pottery, common and hydraulic, mortar, concrete, &c., the working of metals, gas-making, bleaching and dyeing, calico-printing, and the preparation of the various chemical products used in the arts. The manipulations and practices of testing will also be exhibited and applied, particularly in the estimation of the value of lime-stones, alkaline salts, metallic ores, and other chemical products.

Organic Chemistry. (Third Year.)

Daily, from February to May. Fee, 2*l.*

1. Before treating of substances derived from the vegetable and animal kingdoms, the proper subjects of this Course, the principles of Chemical Philosophy will be considered, including a discussion of the atomic theory, the doctrine of volumes, isomorphism, affinity and voltaic electricity.
2. Composition of organic substances; alterations of composition by natural and artificial processes. Varieties of fuel, manufacture of vinegar, fermentation, brewing and distilling. Action of antiseptics.
3. Particular substances. (1.) Ordinary constituents of plants: amylaceous and sac-

charine group, manufactures of starch and sugar; gluten and baking of bread. Lignin; preservation of wood, pyroxylic spirit, acetic acid. Resins and oils, with varnishes and paints. (2.) Extraordinary constituents of plants: colouring matters, &c., indigo, madder, dyewoods, &c., their applications in dyeing and calico-painting. Vegetable acids: preparation of oxalic, tartaric acids, &c. Vegetable alkalies, preparation of salts of quinine and morphine, nicotine and preparation of tobacco.

4. Cyanogen compounds, including the manufacture of prussiate of potash.

5. Growth of plants and chemical principles of agriculture.

6. Animal substances, albumen, fibrin, gelatin, &c.; with preparation of glue, preservation of animal food, soap-making, tanning, &c.

7. Principles of animal nutrition.

PRACTICAL CHEMISTRY.—Professor Fownes, F.R.S.

Instruction in Analytical Chemistry.

The Council, considering the increasing importance of Chemical Science in its relations to Agriculture, Manufactures, and Medicine, and with a view to a more extended course of Laboratory Instruction, have instituted a distinct Professorship of Practical Chemistry, and have erected a spacious Laboratory with complete arrangements for the pursuit of all branches of Chemical Investigation, more especially Organic Research by the Senior Pupils, and for the instruction in Elementary Analysis of those less advanced.

The Laboratory is open daily, from 9 A.M. to 4 P.M., from the Middle of October, until the end of July, with a short recess at Christmas and Easter.

Fee, 25 Guineas, exclusive of the expense of materials, &c.; for 6 Months, 18 Guineas; for 3 Months, 10 Guineas; for 1 Month, 4 Guineas.

The Laboratory is under the joint superintendence and direction of the Professors of Chemistry and of Practical Chemistry.

Elementary Classes of Practical Chemistry.

Under the Direction of Professor Fownes, assisted by Mr. Campbell, Demonstrator.

Summer Course.

A Course of Forty Lessons, of one hour each, on Mondays, Tuesdays, Wednesdays and Thursdays, from 3 to 4, commencing the first week in May.

Payments by Students who are Perpetual to the Class of Chemistry, 3*l*. By other persons, 5*l*. For a second Course, 3*l*. These payments include the cost of Materials, &c.

Birkbeck Course,

for Persons Practically Engaged in Manufactures.

A Course of Fifteen Lessons, of two hours each, on Mondays and Thursdays, from May 9th to end of June. Hours 7 to 9 P.M. Fee, including the cost of Materials, &c., 2*l*.

Each Summer Course will include the most important ordinary operations of the Laboratory, according to the following Classification.

Chemical Manipulation.—Construction of Tube Apparatus. Of the Pneumatic Trough. Filtration, washing of Precipitates, and other operations of Analysis. Use of the Mouth Blowpipe.

Preparations.—Of Gases, Acids, Alkalies, Earths, Metals, and a number of Organic Substances.

Qualitative and Quantitative Analysis.—Of Organic and Inorganic Substances.

All the processes and operations are repeated by each Student, or by not more than two Students jointly.

GEOLOGY.—Lecturer, Mr. Joyce, F.G.S.

First Course:—On Elementary and Practical Geology: about 10 Lectures. Monday, Wednesday, and Friday, from $5\frac{1}{2}$ to $6\frac{1}{2}$, during the month of November.

Subjects.—General view of the Earth's Surface; of the nature, division, and subdivisions of the Strata which form its Crust; of the order of their superposition and of the successive revolutions which have affected them. Details of the practical uses to which Geology has been or may be applied.

Second Course:—General, Physical, and Theoretic Geology. During the months of February, March, and April.

Subjects.—Description in detail of the various rocks, of their peculiar character and position, of the circumstances which have attended their formation, and of the state of the earth at each successive period; causes which have produced or modified the action of disturbing influences. Organic Remains—their changes and importance; the most remarkable fossils described and exemplified. Alterations now in progress on the surface of the globe: comparison of past with present phenomena, and prospects of the future.

FEES:—First Course, 1*l.*; Second Course, 2*l.* 10*s.*; for both Courses, 3*l.*

DRAWING.—Teacher, Mr. G. B. MOORE.

GEOMETRICAL and ISOMETRICAL projection and drawing, including the delineation of shadows, as applicable to ARCHITECTURE, ENGINEERING, and MACHINERY: PERSPECTIVE, LANDSCAPE, and the FIGURE.

Three Courses during the Session:—

1. From 16th October to Christmas. 2. From Christmas to Easter. 3. From Easter to the end of June.

MORNING CLASS.—Monday and Friday, from 2 to 4, Saturday, from 11¼ to 1¼.

EVENING CLASS.—Mondays and Fridays, from 6 to 8½.

FEES:—For one Course of either Class, 2*l.* 2*s.*

CIVIL ENGINEERING.—Professor HARMAN LEWIS, A.M.

Monday, Wednesday, and Friday, First Division from 6 to 7 P.M, Second Division from 7¼ to 8¼. During the months of February, March, April, and May. Fee: for each Division, 5*l.*; for both Divisions in one payment, 9*l.*

Introductory Lecture. Objects of Civil Engineering. Its Divisions. Fundamental and Collateral Sciences. General sketch of each division.

FIRST DIVISION. FIRST YEAR.

INTRODUCTION.—*Mensuration*: Areas and volumes of the principal figures and solids occurring in practice. Principles of the representation on planes of bodies in space. On Plans and Sections: Scales: Construction of working drawings.

A. The principal materials studied will be *Wood, Brick, Stone, Iron.* The different kinds of wood, their decay and preservation. Brick-making: different kinds of Bricks, and their application. Principal stone-quarries. The composition and resistance to disintegration of the chief Building-stones: methods for testing their capability to resist decomposition. Cast and soft iron; preservation of iron: Copper, Lead, Tin, and Zinc.

Cement.—Component parts of Mortar and Cement: their preparation and proportion in different cements. Hydraulic Cements.

Strength and Stress of Material.—On the resistance of bodies to extension and compression in the direction of their length. Rupturing and crushing forces for Brick, Stone, Plaster, Mortar, Wood and Iron, &c. &c. Flexure of a body by a force perpendicular to its length. Theories proposed for the solution of the question. Definition of Moment of Flexure: its value for rectangular, square and cylindrical prisms of substances used in construction, fixed or supported at one or both ends, and the weight being concentrated or not at one point; on the rupture of pieces such as the above. Definition of Moment of Rupture: its value for various substances. Its magnitude depends on time of action. On the flexure of a prism placed vertically and loaded at its superior extremity: Experimental results. On solids of equal resistance for pieces fixed or supported at one or both extremities, and loaded uniformly or not: Practical modification of these forms.

B. SPECIAL CONSTRUCTION.—*Foundations.*—Natural and artificial. Concrete. Beton. Piling. Fascines. Coffer-Dam, Caisson.

Theory of Roofs.—Construction of wood and iron roofs: pressure at points of support.

Arches.—Voussoir theory of the Arch: Polygonal theory. Flat and oblique Arches. Different species of Domes and Vaults. Principles for the construction of Centres.

Slopes and Revetment Walls.—Natural slope assumed by different materials. Earth and rock cutting. Nature of soil, and physical conditions influencing slips. Methods of hindering or remedying these latter: On the contents of Embankments or Cuttings: working drawings for their construction. Theory of retaining walls: Determination of the pressure against them: Superior limit of that pressure. Prism of greatest thrust.

SECOND DIVISION. SECOND YEAR.—General Construction.

C. LAND ENGINEERING.—*Roads*: Principles guiding their route. Road gradients. Survey and Section of the route: Formation of the road.—*Streets*: Wood and Stone Pavements.

Railways.—Selection of a line between two proposed Termini. Trial and final section. Survey of the Line. Plotting the Plan and Section: Gradients, Curves: On the Gauge: Earth-works: Tunnelling: Viaducts. On the Rail, Sleeper and Chair. Power as Locomotive and Stationary Engines. Atmospheric Pressure, &c.

D. HYDRAULIC ENGINEERING.—*Canals*: Principles guiding the selection of their route. Feeders. Ascent and descent of vessels: Locks, Lock-gates, Towing-path.

Water-works.—Reservoirs and supply of towns with water: Filters: Distribution: Passage of fluids in Pipes: Influence of the Jet.

Artesian Wells.—Origin of: Methods of boring.

Sewerage of Towns.—Nature of the sewerage-water: its utility as Manure: Methods proposed to render it available.

Gas Works.—Gas from Coal, Resin, Schist, &c. Distribution of the gas: influence of the Jet. Gas-meters.

River Navigation.—Rivers traced from their source to the Sea: Junction of Rivers: Origin of Shoals: Method for passing a Vessel over them: Removal of Shoals: Dredging, Dams, Weirs. Currents: Effects produced by placing or removing Obstructions to the River Current.

Bridges.—On the Site for and approaches to Bridges: The species of Bridge, as Stone, Wood, Brick, Iron: On the Catenary Curve; and Suspension Bridge.

Formation of Docks.—Retaining Walls, and generally on the employment of Tidal Water.

Mills: Mill Sites: Mills with Undershot and Overshot Wheels: Windmills.

Drainage in general: Of Land, Fens, Marshes: Machines used for Draining: Reclaiming Land from Water.

Tides.—On the Oceanic Tide: Modification of the Tidal Wave by its proximity to Land: Effects of Tides and Waves to change the shore-line of a Coast: On the Breaking Wave, and its mode of action against an opposing body. Régimen of Rivers, and general principles regulating any change in the Shore-line. Principles of Embankments.

Marine Engineering.—Sea Walls, Dikes, and Principles guiding the selection of Harbour Sites. Means of keeping Harbours free: Sluicing, Backwater: Bars, &c. Construction of Piers, Jetties, Quays, Harbours of Refuge: Breakwaters, Beacons: Theory and Construction of Reflecting and Refracting Lighthouses.

E.—VARIOUS ENGINEERING QUESTIONS—as Construction of, and fixing *Lightning Conductors* and *Electric Telegraphs*. *General Theory of Resistance*: Experimental Results and Applications, more especially to Canal, Steam-boats, and Naval Architecture.

SURVEYING.

An Elementary Course of Theoretical and Practical Surveying, under the superintendence of Professor LEWIS, during the months of February, March, April, and May.

Tuesdays, Lecture from $10\frac{1}{4}$ to $11\frac{1}{4}$ A.M.; afterwards, Field Practice; Thursdays, 7 to 9 P.M.

Fee for Students of the Class of Engineering, £5; for others, £6.

FIRST PART.—*Linear Measurement.*—Gunter's Chain and Foot Chain: application to measure lines straight or curved: Plotting Lines: Offset Staff. Methods for determining a right line on the ground, and for fixing a line perpendicular to a given one.

Superficial Measurement.—On the Units of Superficial Measurement. Utility of Gunter's Chain. Areas of Triangles. Quadrilateral and Polygonal Figures.

Surveying by the Chain.—Principles of the Survey of a Tract of Land. Principal and Secondary Triangles. Tie or Check Lines. Methods for continuing Straight Lines, and for measuring inaccessible distances. Reduction of Slopes to the Horizon. Plotting the Survey. Scales. Meridian Line fixed. Acreage. Copying and Reducing Plans.

SECOND PART.—*Surveying with Angular Instruments.*—Construction and adjustment of the Theodolite; application to Surveying. Mensuration of Heights and Distances. Traversing. Survey of Roads, &c.

THIRD PART.—*Levelling.*—Theory of Levelling. Construction and Adjustment of the Y and other Levels: Correction for Curvature and Refraction. Methods of Observation. Field Book. Reduction of the Levels and Plotting the Section.

FOURTH PART.—*Trigonometrical Surveying.*—General Explanation of the Principles and Operations: Instruments employed: Reduction of Angles to a given plane: Determination of the Meridian: Refraction: Levelling: Pendulum Observations: Geographical Latitude and Longitude: Figure of the Earth.

Appendix.—Mensuration of Heights by the Barometer.

MECHANICAL PRINCIPLES OF ENGINEERING.—Professor EATON HODGKINSON, F.R.S.

LECTURES ON THE STRENGTH OF MATERIALS AND ON MACHINERY.

Tuesdays and Thursdays during the months of January, February and March, $4\frac{1}{2}$ to $5\frac{1}{2}$. Fee, 4*l.*

In the commencement of these Lectures will be given a short review of the progress of knowledge on the subject from its rude beginning under Galileo to the present time. The Course will comprise the results of theory and experiment on the resistance of materials to tension, compression, transverse flexure as in beams, and torsion. The resistance of materials will be considered both with regard to *moderate* strains—within the range of practical utility, the limit of which will, as far as possible, be defined—and to *ultimate* ones, showing the breaking weight; the force being either simple pressure or impact. The relative fitness of the different building materials, as cast iron, wrought iron, steel, timber and stone, for the various purposes of Engineering and Architecture, will be shown; as likewise the strength of each to resist the different strains above-mentioned. The best forms of beams and pillars, as deduced from numerous and recent experiments, principally on cast iron, with the theory of their strength, and short rules for estimating it, will be given. The *Defect of Elasticity*, which affects rigid bodies generally, and particularly cast iron, will be described; together with the approximate law of its action, and the influence of this on the general theory of the strength of materials. In these Lectures, which it is hoped will include important results not previously given, the theory will be illustrated by a description of a great number of original experiments, many of them on a large scale, and made with very superior apparatus, upon most of the materials used in constructions, including, besides experiments on cast and wrought iron, many upon the leading building stones, and upon various kinds of timber, the results of which have not been published. The Lectures will likewise contain an account of the Author's unpublished experiments on the strength and other properties of tubes of wrought iron, and of wrought iron conjoined with cast, made on account of the tubular bridge intended to cross the Menai Straits.

Another short Course of Lectures will contain the theory of various machines, as the steam-engine, both stationary and locomotive, the water-wheel, &c., and the work done by each of these; theory of bridges; the construction of fire-proof buildings, &c.; with some other matter from Poncelet and Moseley.

DESCRIPTIVE MACHINERY.—Professor BENNETT WOODCROFT.

Introductory Lecture on the History of Inventions for propelling Vessels.

SUBJECTS OF THE COURSE.—Elementary parts of Machines: formation of those parts: simple combinations of the parts with their uses in changing and transferring motion: application of those parts in the Construction of Machines for Practical use: gradual advance from simple to complicative machines: the manufactures produced by various machines.

(*Further particulars, with the Times of Lecture, &c., will be given in a subsequent edition*).

ARCHITECTURE AND CONSTRUCTION.—Prof. Donaldson, M.I.B.A.

This subject will be divided into four separate Courses, under two heads;—Architecture as a Fine Art, A. Architecture as a Science, B. Each Course will consist of 25 or 30 Lectures in the year, and will be divided into three parts of 8 or 10 Lectures, one of which will be delivered every week.

First year's Course,—A.—Tuesday, 6 to 7 P.M.
B.—Thursday, 6 to 7 P.M.
Second year's Course,—A.—Tuesday, $7\frac{1}{4}$ to $8\frac{1}{4}$ P.M.
B.—Thursday, $7\frac{1}{4}$ to $8\frac{1}{4}$ P.M.

Fee for one year's Course in either A. or B., 3*l.*; for both, 5*l.*

Fee for two years' Courses in either A. or B., 5*l.*; or for two years' Courses in both, 9*l.*

A.—*Art*: Division of the Architecture of Monumental Buildings into Styles, either of countries or periods, each style reducible into certain subdivisions, as in Classical Architecture the *Orders*. Constituent Members of an Order, Pedestal, Column, Entablature; classification of Mouldings and Ornament, with the peculiarities of the Greek and Roman profiles and enrichments contrasted; Doric, Ionic, and Corinthian Orders, their forms and proportions, and various modifications, as in the Tuscan and Composite Styles of Architecture, and examination of the essential differences which distinguish each. Egyptian, Greek, Roman, Byzantine, Norman, Pointed, Ogival, Revival, Italian, and its Modifications in France, Germany and England; Eastern Architecture, as Chinese, Indian, Turkish, and Moresque; Western Architecture, as Mexican. Principles of Architectural Composition with respect to Convenience, Solidity and Decoration (Æsthetics); rules to be observed in distribution of Plans, whether in single apartments or rooms, or in a group of several; on grouping several parts of a Composition in one Building; on grouping an assemblage of Buildings in Plan, and the most judicious mode of laying down a Plan for a City; on the different parts of Elevations of Buildings, considered separately or individually in themselves, and relatively with each other, as Porticoes, Colonnades, Domes or Cupolas, Towers, Doors, Niches, Windows, &c.; Grouping of several Buildings in Elevation. Peculiarities requisite in designing Edifices, such as Churches, County Halls, Courts of Justice, Prisons, Hospitals, Houses of Parliament, Theatres, Markets, Bazaars, Public Institution, Custom Houses, Government Offices, Barracks, Arsenals, Docks, Exchanges, Insurance and Banking Offices, Libraries, Museums, Baths, Palaces, Private Houses, and other classes of dwellings, as Farms, and also Stables and Riding Houses. Modes of measuring Plans and Elevations of Edifices, ancient and modern. History of the Buildings of the principal Architects, and Books on Architecture. On the Education of an Architect; his character, attainments and duties.

B.—*Science*: Construction; Materials, their properties, and method of experimenting; selection and mode of application. Materials of two descriptions—Vegetable and Mineral.

1. *Vegetable.—Timber*: On the Natural Structure of a Tree, and the varieties of Timber Trees; different sorts of Timber, and the mode in which it is manufactured for the market: on dry rot, its prevention and cure. On the Resistance or Force of Timber in reference to Tension, Compression and Torsion; of the Theory and Resolution of Forces, and the practical application of these mathematical principles to Framing of Roofs with king-trusses, queen-trusses, compound trusses, Gothic collar Roofs, Cupolas, Spires; the Systems of Philibert de Lorme, Mansard, Laves; construction of Floors, whether single-joisted or framed, and the framing of partitions, shoring and scaffolding, with an analytical investigation of different modes of scarfing, jointing and articulation of timbers at points of juncture.

2. *Mineral.*—Limestones for the purpose of mortars, which may be divided into two classes, *Calcareous* Cements and *Aluminous* Cements.—1. *Calcareous* Cements; Selection of stones for the purpose of conversion into lime; process of calcination; different forms of kilns. Of mortars, and of the substances which enter with lime into their composition, divided into *inert*, as sand, ashes, cinders, scoriæ, and burning clay; *active*, as traas, pozzolana, and metallic oxides: concrete, hydraulic mortars, and various artificial compounds. On plaster and stucco; selection of the gypsum or alabaster, and calcination and preparation for use; method of application, on walls, ceilings, in mouldings, cornices, and ornaments; Patent Inventions, as Martin's, Kean's and Loriot's mastics. 2. *Aluminous* Cements: discovery of this class by Dr. Parker; description of different sort of natural cement stones, their tests; mode of burning and pulverization, application; artificial aluminous cements, as Frost's, Pasley's.

Masonry.—Foundations in different soils, with concrete. Solid construction with stone: selection of quality for different purposes, and examination of the causes of disintegration;

Brard's system of testing by salts. Granite and other plutonic rocks, stratified rocks, as limestone and sandstone, Portland, Bath, Yorkshire, &c. Method of application in buildings, walls, piers, columns, arches, vaults, buttresses, staircases, "Coupe des pierres." *Brickwork*: Different sorts of bricks and peculiar fitness for different purposes; method of making and burning; construction of old English bond and Flemish bond, and their relative values; herring-bone courses; hollow walls; flues; brickwork in mortar, in cement, in walls: Brunel's system, with iron-hooping; construction in arches and vaults; chimney shafts. *Roofing* with slates and tiles; of the different qualities and sizes of slates, and proper method of laying them. *Damp*, its prevention and cure.

Metals.—Iron: Different qualities of wrought and cast iron; application for bond in walls, in ties and cramps for stone and woodwork, piping, guttering. *Copper* used for monumental columns, and for covering flats and roofs, and as cramps, plugs, dowels, nails, &c. *Lead* for roofing, gutters, cisterns, pipes, plugs, &c. *Zinc* for roofing, guttering, pipes.

Painting.—Fabrication of colours, and application in oil or distemper; graining in imitation of marbles and woods. *Varnishes*, their composition and application.

Glazing: the different sorts of glass, plate, flatted, British plate, crown glass, and their application, whether to lead lights or sashes with large squares.

Ventilation, Heating, Lighting, Acoustics, Sewerage, Drainage.

The entire Course of instruction in these branches embraces two years, and consists of 100 or 120 Lectures: some of the Students however attend both years' Courses at once. During the Session some of the buildings in London are visited by the Classes, and their construction and design explained by the Professor, and each subject is illustrated by full-sized drawings of the finest examples.

Periodical Examinations will take place throughout the Course. The Students are expected to take notes.

A COLLEGE FEE of 10*s.* for one Class, and 1*l.* for two or more Classes, is paid by each Student every Session: where, however, the Course is of short duration, this fee is diminished. The MATRICULATION FEE of 2*l.* relieves the Student, during the whole course of his study, from the College Fee.

RESIDENCE OF STUDENTS.

Several of the Professors, and some of the Masters of the Junior School, receive Students to reside with them; and in the office of the College there is kept a Register of Parties unconnected with the College who receive Boarders into their families; among these are several Medical Gentlemen. The Register will afford information as to terms and other particulars.

CHARLES C. ATKINSON,
Secretary to the Council.

FRANCIS W. NEWMAN,
Dean of the Faculty of Arts.

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